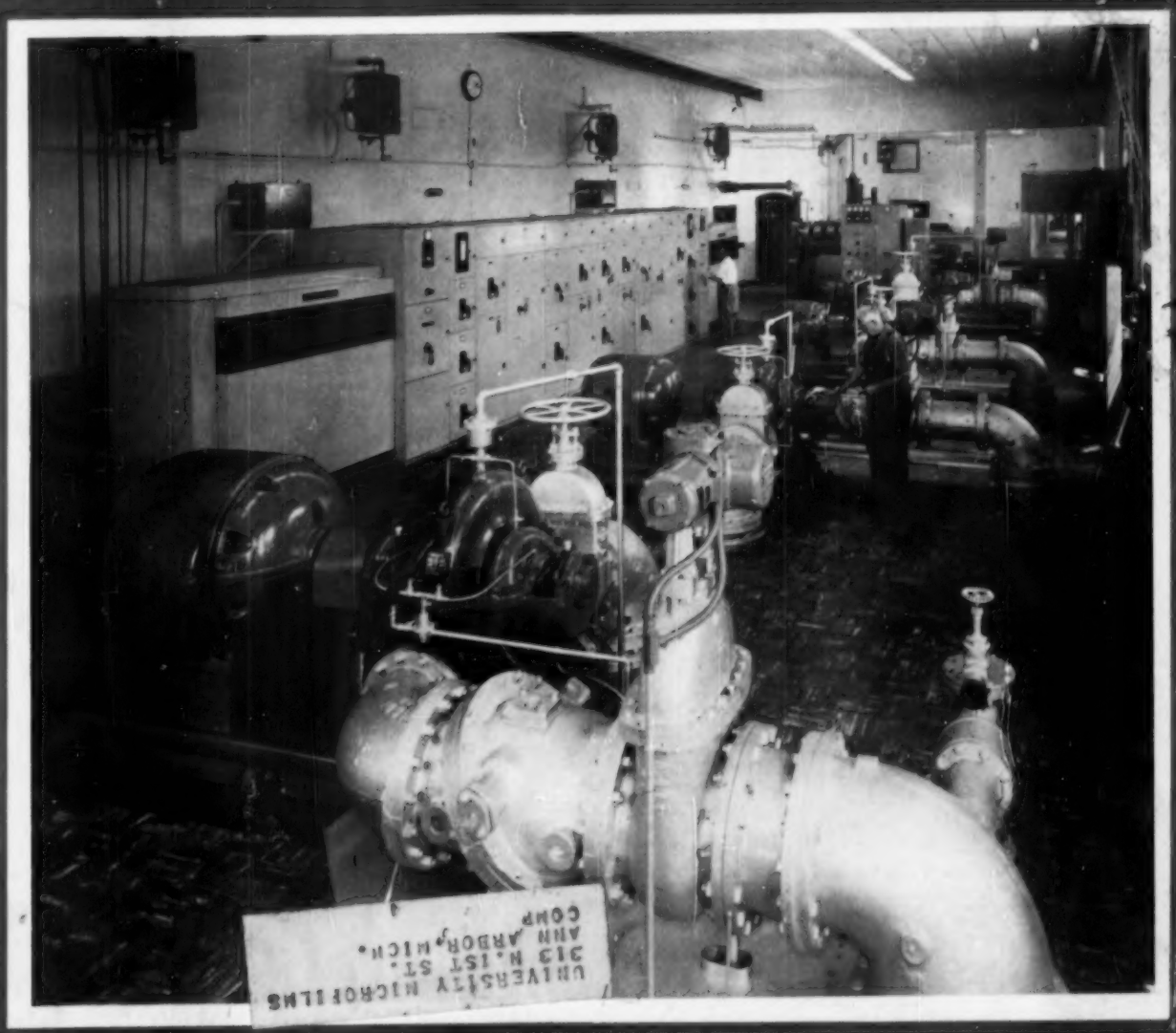
SECTION 1*

WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL

*Section 2 is 1954 Index



Electric Drive Replaces Steam at Tonawanda, N. Y.
See Water Supply Progress in 1954—Page 1

How Pipe Line Cleaning Saves Money

Community Sewage Disposal by High-Rate Leaching

JANUARY 1955

580 times more water than flows over Niagara Falls!

IN 50 YEARS Lock Joint Pipe Company has developed and produced concrete pressure pipe for countless water works installations throughout the world. Today, at any given second of the day or night, these pipes are transporting better than 1,000,000,000 gallons of water — or more than 580 times as much water as is flowing over Niagara Falls.

This is the measure of the tremendous contribution Lock Joint Pipe has made, over the past half century, toward meeting one of civilization's most serious problems — water supply.

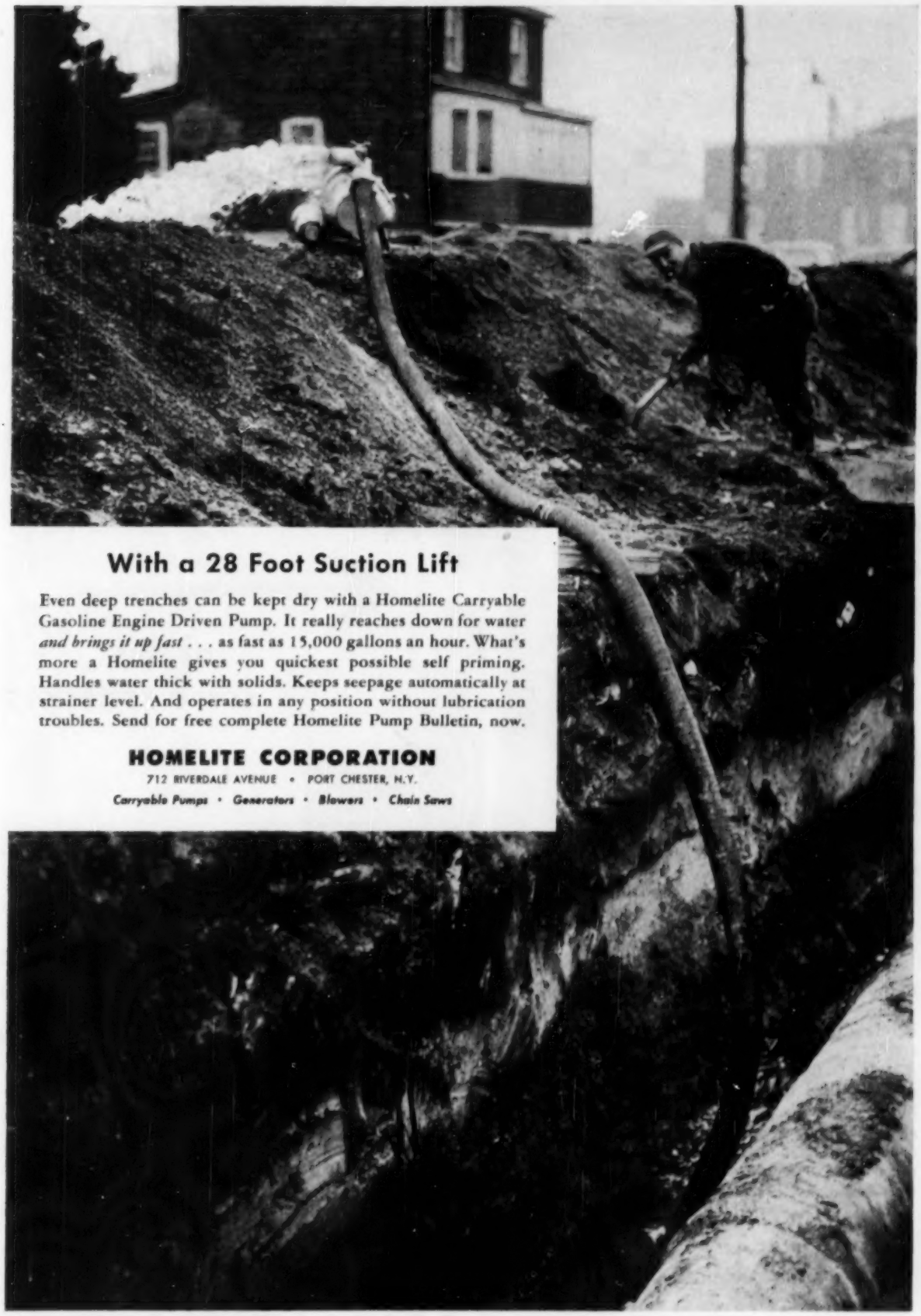
You may be sure that every resource of skill, experience and research at our command is at this very moment working on the answers to the even greater problems we must meet in the *next* 50 years!

LOCK JOINT PIPE COMPANY

Established 1905

P. O. Box 269, East Orange, N. J.

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Mo.



With a 28 Foot Suction Lift

Even deep trenches can be kept dry with a Homelite Carryable Gasoline Engine Driven Pump. It really reaches down for water *and brings it up fast* . . . as fast as 15,000 gallons an hour. What's more a Homelite gives you quickest possible self priming. Handles water thick with solids. Keeps seepage automatically at strainer level. And operates in any position without lubrication troubles. Send for free complete Homelite Pump Bulletin, now.

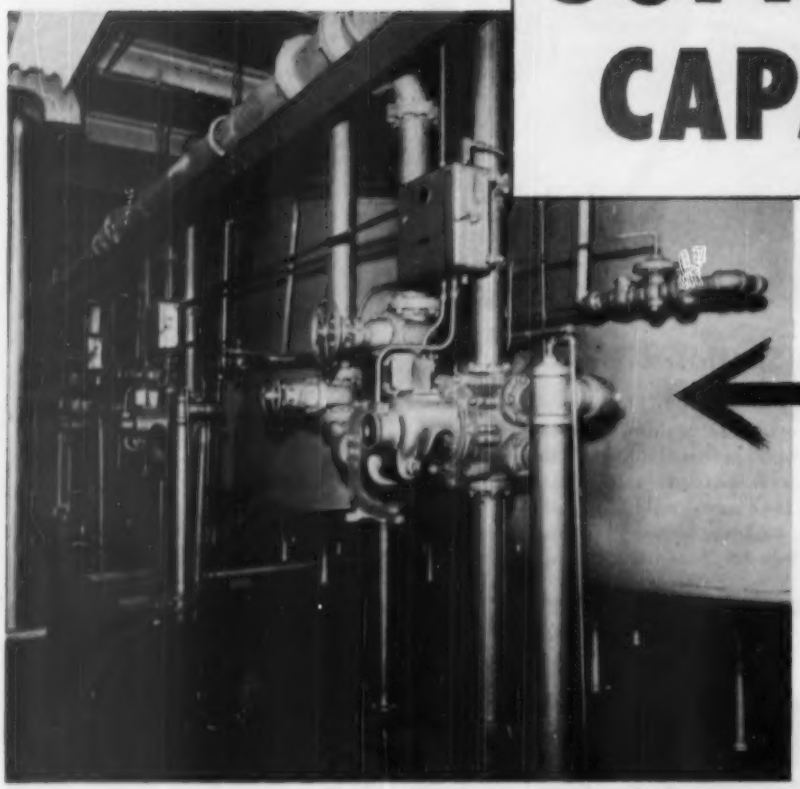
HOMELITE CORPORATION

712 RIVERDALE AVENUE • PORT CHESTER, N.Y.

Carryable Pumps • Generators • Blowers • Chain Saws

How the Town of Normal, Illinois

TRIPLED SOFTENING CAPACITY



...of the same softeners

...by changing to PERMUTIT Q

Replacing old-fashioned zeolite with the high-capacity ion exchange resin, Permutit Q, saves Normal over $7,000 a year!

Normal's three automatic softeners were installed back in 1946, before high-capacity Permutit Q was available. Each softener removed hardness from 83,000 gallons of water between regenerations for a daily delivery of 700,000 gallons of softened water.

Recently town officials called in Consulting Engineers, Farnsworth and Conley, of Bloomington, Illinois, who recommended replacing zeolite with modern, high-capacity Permutit Q.

Look at the benefits gained from this change! The capacity of each softener is up from 83 to 270 thousand gallons between regenerations. Salt Consumption – down to about ¼ lb. per thousand grains of hardness removed. Flow Rate–up from 285 to 510 gpm. Regenerations – down from 3 times to once per day per softener.

A change to Permutit Q may effect similar economies for your city. We'll gladly send helpful data.

The Permutit Company, Dept. W-1, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS

PERMUTIT®

WATER AND SEWAGE WORKS, Reg. U. S. Patent Off. Published monthly by Scranton Publishing Co., at 5th and Ferry St., Lafayette, Ind. Entered as second class matter at the post office at Lafayette, Ind., under Act of March 3, 1879. For subscription rates, see Contents Page.

WATER & SEWAGE WORKS

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INDUSTRIAL WASTE TREATMENT

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Fluoridation by Automatic Control
Diatomite Filtration
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Civil Defense Aspects of Water Supply Planning
Storm Flow Management at a Sewage Treatment Plant
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Cover Photo Courtesy of General Electric Co.

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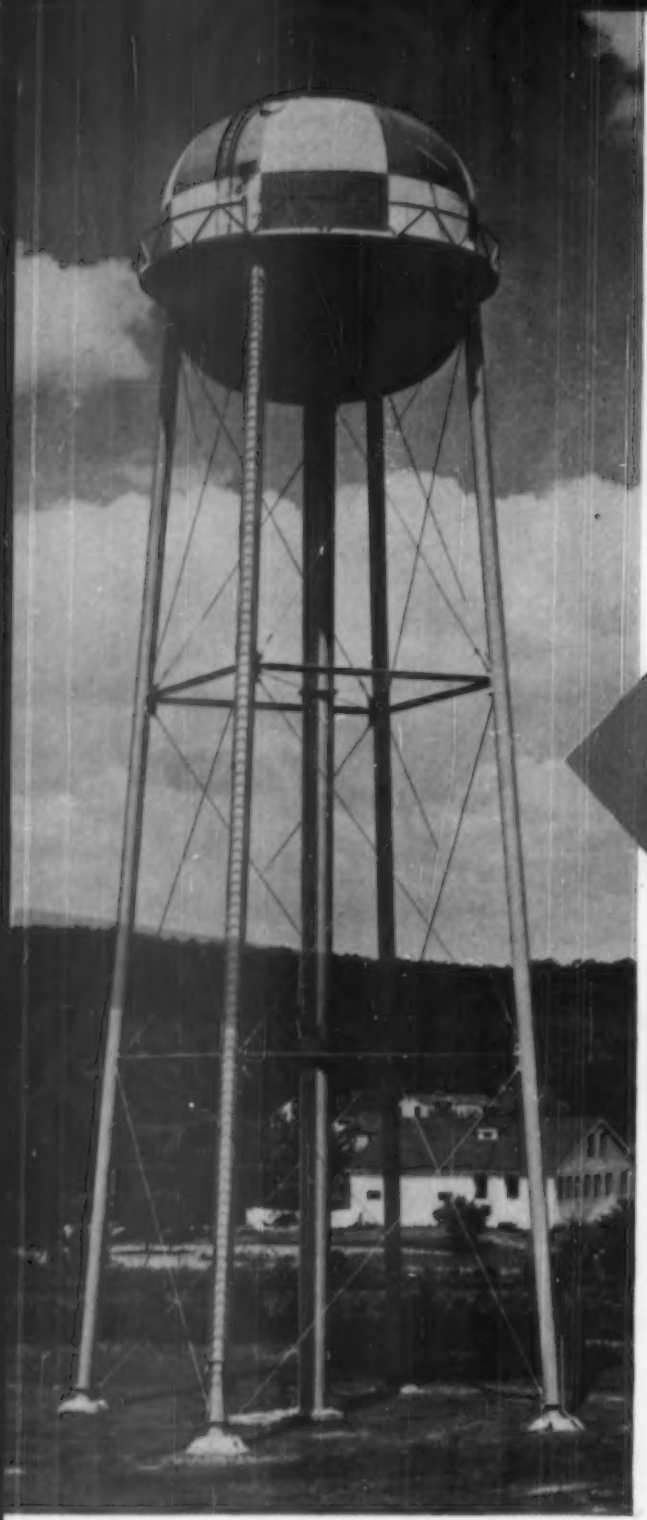

PITTSBURGH •DES MOINES

Elevated Steel Tanks

The Classic

"100 on a 100"

—most popular with smaller communities for handling average water storage needs

One hundred thousand gallons, on a hundred-foot tower: that's a most frequent Pittsburgh-Des Moines elevated steel tank specification. And the "100 on a 100" provides top value, too—it is a standard product, handsome in appearance because of fine proportions, but without costly frills. Your community dollar goes a long way with this popular double-ellipsoidal, low head range design. Let us give you the comparative facts, and consult on your water storage requirement.

A variety of P-DM tank types are detailed in our "Modern Water Storage" Catalog. *Write for your free copy.*

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

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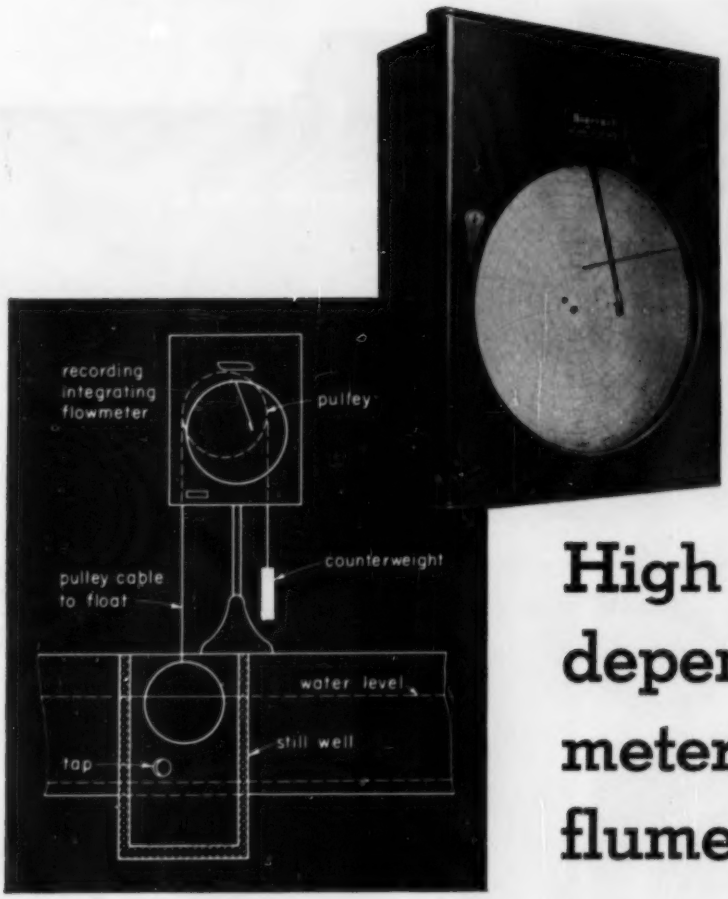
NEWARK (2)	218 Industrial Office Bldg.	DALLAS (1)	1223 Praetorian Bldg.
CHICAGO (3)	1222 First National Bank Bldg.	SEATTLE	526 Lane Street
LOS ANGELES (48)	6300 Wilshire Blvd.	SANTA CLARA, CAL.	625 Alviso Road



High accuracy and dependability for metering flow in flumes and weirs

Typical installation of Brown Float-Actuated Flow Meter used with Parshall flume. Instrument is rugged, simple, accurate to ± 1% of scale.

SANITARY ENGINEERS will appreciate the simplicity and accuracy of the rugged Brown Float-Actuated Flow Meter. Specially designed for use with Parshall flumes and rectangular, Cipolletti, or V-notch weirs, the instrument provides—at economical cost—*direct* measurement of flow accurate to ± 1% of scale.

The meter is built for long, dependable service . . . has a minimum number of moving parts. A hollow metal float, connected to the meter by a stainless steel cable, rides the surface of the liquid in a stilling well tapped off the flume or weir. As liquid level rises and falls, the float rotates a precision-machined pulley and cam system in the meter. The instrument indicates, records, totalizes, or controls flow . . . as desired.

Brown Float-Actuated Flow Meters can be mounted indoors, or at remote locations in weatherproof cubicles. They are simple to calibrate—all it takes is a screwdriver. And they'll hold their calibration indefinitely.

Brown Flow Meters are available with a wide choice of controls, including flexible pneumatic control of flow and chemical feeding rates. And where electric or pneumatic power may not be available, a hand-wound chart drive can be included—an especially useful feature for consulting engineers on survey work.

Your nearby Honeywell sales engineer will be glad to discuss the Brown Float-Actuated Flow Meter with you and your consulting engineer. Give him a call . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

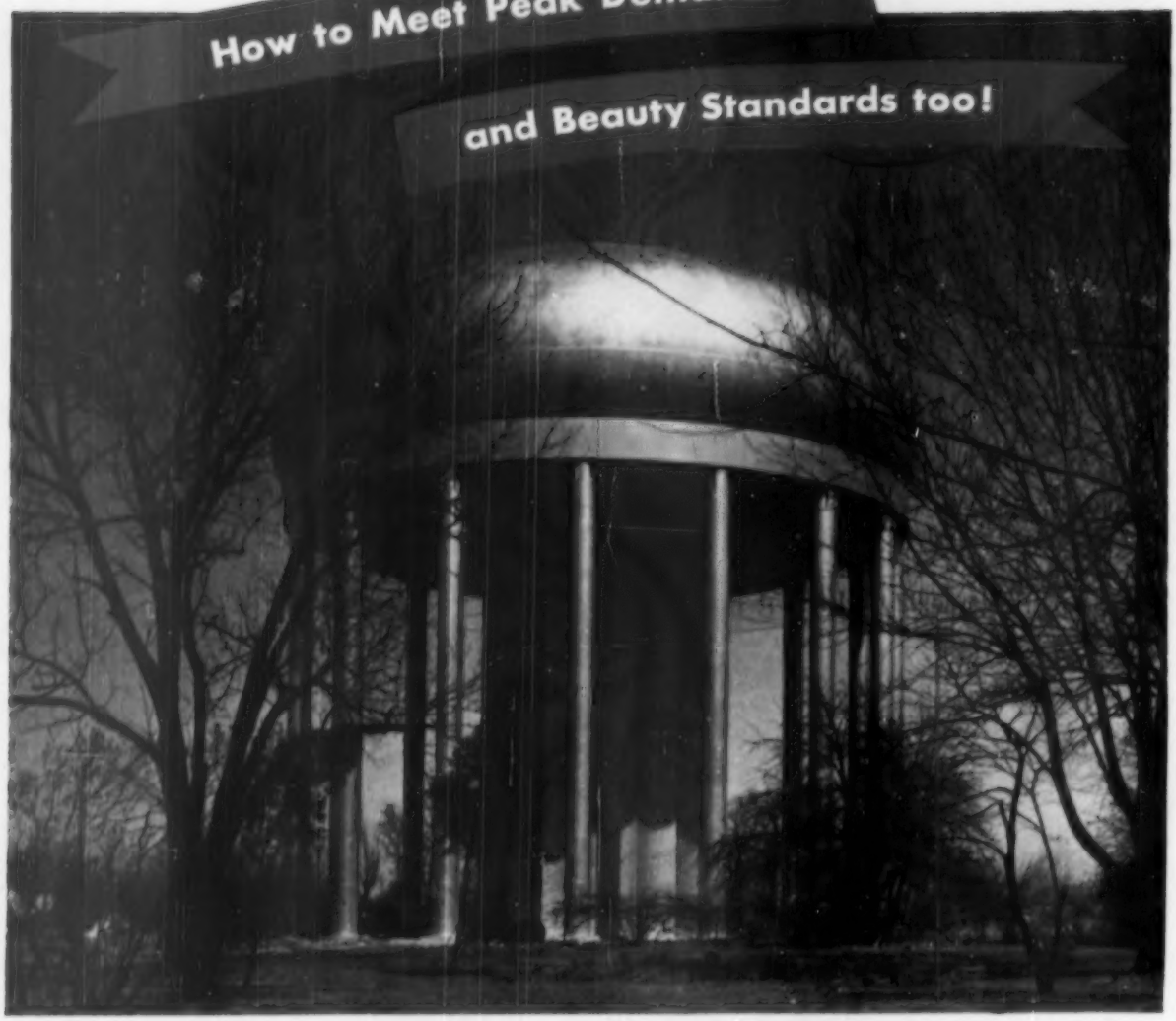
● **REFERENCE DATA:** Write for Honeywell Instrumentation Data Sheet No. 10.3-4a, "Brown Float-Actuated Flow Meters," and for Bulletin 7302, "Instrumentation for Water, Sewage, and Industrial Waste Treatment."

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

How to Meet Peak Demands and Beauty Standards too!



Extreme peak periods of demand, as great as 450 per cent above average annual demand in some sections, called for many improvements in the water works system of Cincinnati, Ohio. The Western Hills section, one of the most remote from the source of water supply, had extremely high peak periods of short duration. The 2,500,000-gal. Hortonspheroidal® elevated tank shown above was erected in that area to help solve the problem of these water shortages.

The Hortonspheroidal design was chosen because of the excellent appearance it would make in a residential neighborhood. An ugly structure, no matter how useful, can lower property values in surrounding area.

Perhaps your city's water demand has increased to a point where present demands are overtaxing facilities. A CB&I engineer will be happy to supply information, estimates or quotations on the Horton elevated tank best suited to solve your water problems.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3 ..... 2181 Healey Bldg.	Detroit 26 ..... 1551 Lafayette Bldg.	Pittsburgh 19 ..... 3260 Alcoa Bldg.
Birmingham 1 ..... 1586 North Fiftieth St.	Houston 2 ..... 2115 C & I Life Bldg.	Salt Lake City 4 ..... 550 W. 17th South St.
Boston 10 ..... 1048—201 Devonshire St.	Los Angeles 17 ..... 1555 General Petroleum Bldg.	San Francisco 4 ..... 1583—200 Bush St.
Chicago 4 ..... 2198 McCormick Bldg.	New York 6 ..... 3390—165 Broadway Bldg.	Seattle 1 ..... 1350 Henry Bldg.
Cleveland 15 ..... 2262 Midland Bldg.	Philadelphia 3 ..... 1644—1700 Walnut St. Bldg.	Tulsa 3 ..... 1646 Hunt Bldg.

PLANTS IN BIRMINGHAM, CHICAGO, SALT LAKE CITY AND GREENVILLE, PENNSYLVANIA

NEW OLIVER 88WT Hydro-Trencher

Digs to 10 feet in toughest going!

Here is a trencher that won't stop when it comes to rocks or roots. Tremendous hydraulic down pressure forces the half-yard bucket into the ground for a fast, full load. New dual-circuit control gives constant pressure, more positive control and greater flexibility in any kind of going.

Take a close look at this new trencher. It reaches long and digs deep. Its simple, sturdy construction and all-hydraulic operation give low maintenance and long service. The hydraulic stabilizer blade not only holds the tractor level and steady, but is an excellent back-filler blade. And, by simply turning the trencher bucket around you have an efficient swing loader.

Test the new Oliver 88WT Hydro-Trencher on your work. See how easy it is to operate and how readily it digs or loads the toughest material. And remember, the 88WT is ready to work or move instantly, and takes only one man to operate. Get in touch with your Oliver Industrial Distributor for a demonstration, soon!

Right through the roadbed! Powerful hydraulic down pressure digs through this material with ease. Positive dual-circuit control gives a choice of *three* separate lift or drop speeds on the boom for any condition. Bucket rotation and dipper stick design permit clamping rocks larger than the bucket itself. Special boom cylinder available for digging to 12 feet.

It's a swing loader, too! Remove the bucket hinge pin and turn the bucket around. In minutes the trencher becomes a loader. No extra parts are needed. The exceptional bucket rotation permits loading into a truck up to 10 feet, 6 inches. Optional loading bucket loads up to 12 feet.

One-half yard bucket! The fast hydraulic operation and big bucket capacity of the 88WT let you do more in less time. All-hydraulic operation means, too, that there are no expensive cables or clutches to replace. Maintenance is simple and low cost.

THE OLIVER CORPORATION

400 West Madison Street, Chicago 6, Illinois

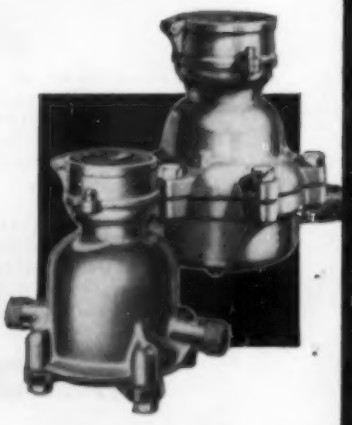
Water is vital...

Badger meters conserve it better!

More than 37-billion cans of food were used by American families last year . . . yet it took *more water than produce* to make these canned products available. For example, more than 15 pounds of water were required for every pound of canned vegetables sold.

Little wonder, then, that Badger meters serve so importantly in thousands of communities. They make certain that homes and industries receive a fair share of the water supply . . . pay only for the water they use.

Famous Badger meters measure water precisely . . . help eliminate waste . . . make water departments more efficient and self-supporting. And service records prove the dependability of Badger meters . . . prove that there are no finer water meters to be had — anywhere!

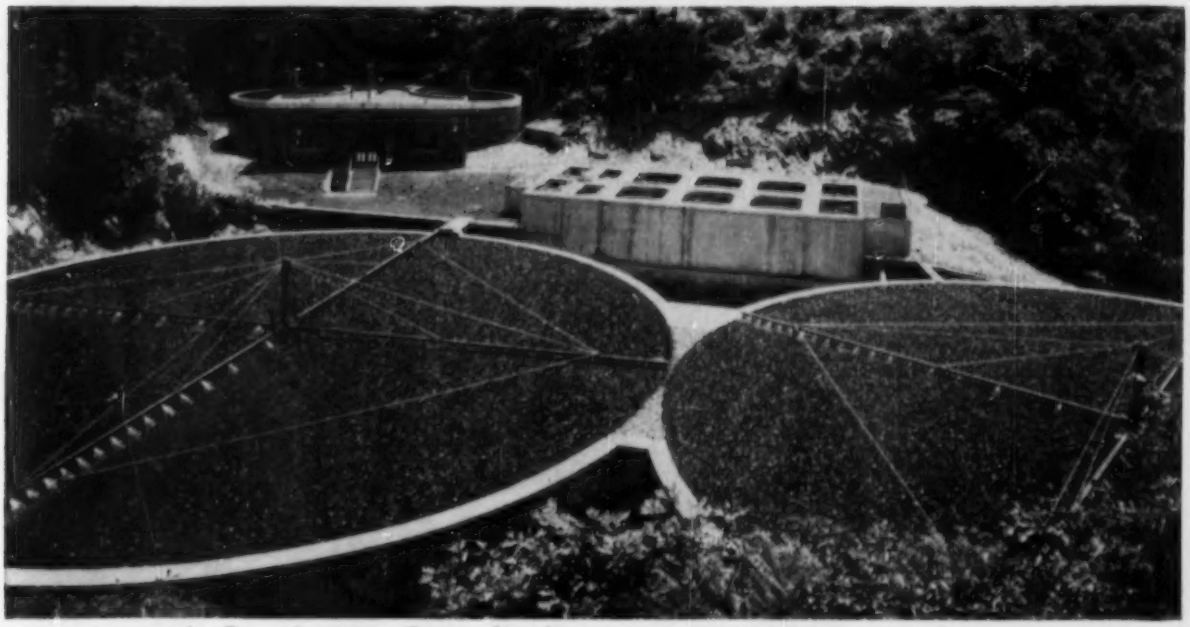


Badger Water Meters

Badger Meter Mfg. Co.
Milwaukee 45, Wisconsin

"Measuring the water of the world for 50 years"

Foreground: enlarged filter bed with 2 PFT 100′ Rotary Distributors



At Downingtown, Pennsylvania . . .

Existing structures are put to better use

WITH MODERN PFT EQUIPMENT

Serving a population of 10,000, Downingtown's old (1916) sewage treatment plant faced the problem of capacity—its circular Imhoff Tank and fixed nozzle filter bed were inadequate for current needs. Solution: expansion from present structures using *PFT equipment for more effective treatment!*

To improve the filter system, the original fixed nozzle filter bed was enlarged and converted into two circular filters, each 100 ft. in diameter. A *PFT Rotary Distributor* is installed on each bed for uniform distribution and trouble-free service. Specially designed spreader jets on the PFT Distributors reduce clogging and are easily cleaned.

The Imhoff Tank was converted to a digestion tank and a second tank was added, both 25′ in diameter. A *PFT Floating Cover* is installed in each digester for positive scum submergence, safe utilization of gas and simplified operation. A PFT Supernatant Liquor Selector in each digester provides automatic, continuous withdrawal of the best digester liquor.

A new control building located between the digesters contains additional PFT equipment for operational control: (1) *Supernatant Gauge, Sight Glass and Sampler* units for close control of supernatant withdrawal, (2) *Gas Safety Equipment*, (3) *Heater & Heat Exchanger* unit with capacity of 250,000 B.t.u. per hour. Fired by either gas or oil, the heater utilizes all gas produced by the digesters, switching to oil only when necessary. Heating *externally*, the unit allows complete accessibility and simplifies cleaning and maintenance.

Design of plant by / Edwin B. Wagner, Downingtown, Pa.

P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
Chicago 13, Illinois

PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLESTON N. C. • JACKSONVILLE • DENVER

For constant and efficient
service at the lowest
maintenance cost
always use
HERSEY
WATER METERS
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MUELLER®

INSERTING VALVES AND EQUIPMENT

ADD NEEDED CONTROL— AT VITAL POINTS...

H-800
Sizes 4", 6", 8"
Shipment from stock

without a

SHUTDOWN!

Avoid fire hazard and customer inconvenience! There is no longer any need to shut down any part of your water distribution system to install needed control valves at strategic locations.

Mueller Inserting Valves are installed in any existing line under pressure without interruption of flow or loss of water and are operated like an ordinary gate valve. Mechanism is identical to that of standard Mueller AWWA Gate Valves. Parts are interchangeable.

Write today for Catalog H-20 or consult your Mueller Representative.

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS

Compliments not Complaints about the taste of your water!

CITY OF WATERTOWN, NEW YORK
WATER DEPARTMENT
THOMAS B. TYLOSLEY
Superintendent

Industrial Chemical Sales Division
West Virginia Pulp & Paper Company
230 Park Avenue
New York 17, New York

Attention: Mr. J. E. Drudy

Gentlemen:

Please accept my thanks and appreciation for your recent immediate response to, and cooperation with our consultants, Malcolm Pirnie Engineers. The work done by Mr. Henry F. Laughlin, your Assistant Director of Research, and Mr. John Foster of Malcolm Pirnie Engineers in determining a treatment to eliminate the bad taste and odor present in our water last October and November gave immediate results.

The recommended treatment of 12 pounds of Aqua Nuchar in slurry form applied directly to the tops of the filters reduced the threshold odor from 18 to 2 with the result that we soon began to receive compliments on our water in place of the flood of complaints that had been customary.

The occurrence of bad taste in our water has been extremely erratic in the past and it may be some time before it develops again but I am sure that your Research Staff has given us a method of treatment that will successfully combat future trouble.

Sincerely yours
Thomas B. Tyloslay
Superintendent

TBT/sml
cc: Malcolm Pirnie Engrs.

● Water treated with AQUA NUCHAR — activated carbon — is more agreeable to the senses of taste and smell. Moreover, the sparkling appearance—(cut diamond effect)—of such water has an enhanced aesthetic value both for the water plant operator *and* for the consumer. AQUA NUCHAR, thus, helps provide water that is palatable to the taste and smell as well as pleasing to the sight.

Threshold Odor Technicians from INDUSTRIAL will be pleased to work with you, *without obligation,* to seek out the most economical means of employing AQUA NUCHAR in your system. These Technicians, *as part of their regular service,* will assist you in the techniques of making the Threshold Odor Test. INDUSTRIAL will run an odor survey of your plant and determine the proper point for application of the carbon. Likewise, a check will be made on the influences of other chemicals used in your process to ascertain the most efficient point of AQUA NUCHAR application.

Contact INDUSTRIAL, now!

industrial
CHEMICAL SALES
division west virginia pulp and paper company

Photograph: Mr. John Foster, Malcom Pirnie Engrs. (left), and Mr. Henry F. Laughlin (center), INDUSTRIAL'S Assistant Director of Research, work with Mr. Dale Lawson (right), Watertown, N. Y., Water Department.

Photograph through courtesy of
WATERTOWN DAILY TIMES

INSURES PALATABLE NUCHAR DRINKING WATER

New York Central Bldg.
230 Park Ave.
New York 17, N. Y.

Pure Oil Bldg.
35 E. Wacker Dr.
Chicago 1, Ill.

Lincoln-Liberty Bldg.
Broad & Chestnut
Philadelphia 7, Pa.

2775 S. Moreland Blvd.
Cleveland 20, Ohio

Part of a 13-mile installation of "Century" Pipe, Lakewood Water District, near Tacoma, Wash.

NON-CORROSIVE

"CENTURY" PIPE

is made of asbestos fiber and portland cement—two practically indestructible materials. It cannot corrode. Therefore, the replacement and maintenance expense necessitated by corrosion and tuberculation, when some other types of pipe are used, is eliminated.

More and more tax-conscious communities are turning to low-cost "CENTURY" Pipe. We will gladly furnish information about its advantages in your specific operation. Write today.

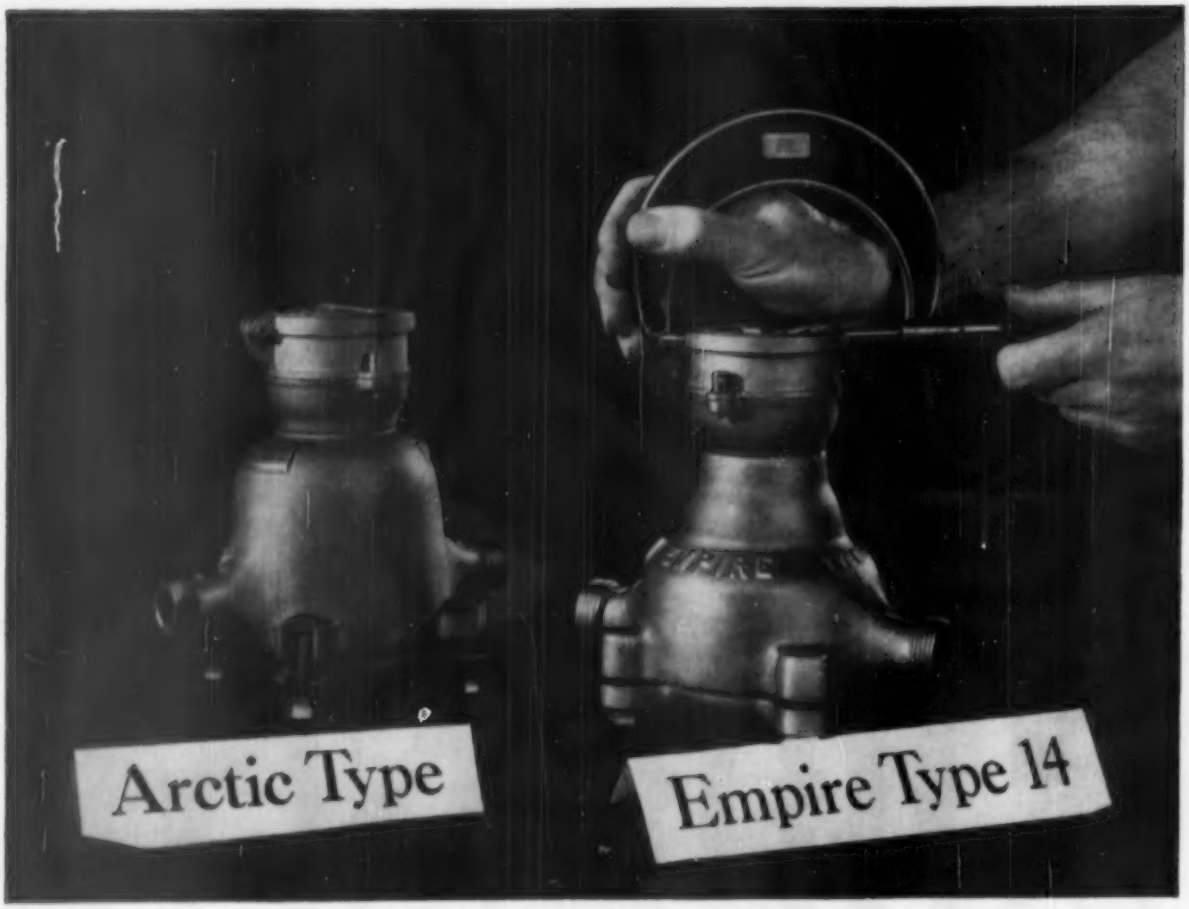
QUALITIES THAT MAKE "CENTURY" PIPE ECONOMICAL, TROUBLE-FREE, LONG-LIVED

1. NON-TUBERCULATING
2. NON-CORROSIVE
3. EXCEPTIONALLY STRONG
4. DURABLE
5. IMMUNE TO ELECTROLYSIS
6. TIGHT JOINTS
7. SMOOTH BORE
8. EASILY, QUICKLY LAID
9. LIGHT WEIGHT
10. LOW COST

"Century" Pipe meets the A.W.W.A., A.S.T.M. and Federal Specifications for asbestos-cement pressure pipe.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

Nature made asbestos . . . Keasbey & Mattison has made it serve mankind since 1873



How Do You Measure Quality In Water Meters ?

You can't put a gauge on quality . . . and only in part a price. You who have been "through the mill" know that quality in water meters must be demonstrated over the years by superior performance, greater accuracy, longer life. Then it's a matter of record.

By any yardstick Rockwell meters measure up to the highest standards. They provide the most in accuracy with the least wear. It adds up to greater earning power, fewer repairs, lowest cost per unit measured. Ask our representative to demonstrate or write for bulletins.

The Symbol for Service, Quality and Performance in Water Meters

ROCKWELL MANUFACTURING COMPANY

PITTSBURGH 8, PA. Atlanta Boston Charlotte Chicago Dallas Houston Los Angeles Midland, Texas
N. Kansas City, Mo. New York Philadelphia Pittsburgh San Francisco Seattle Shreveport, La. Tulsa

ROCKWELL WATER METERS

how much does it cost...

to have *Safest* CHLORINATION?

Nothing—when you buy a Fischer & Porter Chlorinator. That's true because fool-proof safety features are already engineered into this modern, instrument-type chlorinator.

> The F&P Chlorinator is instrument engineered from top to bottom to be absolutely safe in any emergency—and the safety features respond instantly. The mechanical design—without hydraulic devices to introduce time lag—make this a certainty . . .

In the F&P Chlorinator you can take a hammer and shatter the flowmeter tube—and the chlorinator shuts down *instantly*.

In the F&P Chlorinator you can pull the flow setting needle valve right out of its socket—and the chlorinator shuts down *instantly*.

In the F&P Chlorinator you can shut off the ejector water supply while leaving the chlorine on—and the chlorinator shuts down *instantly*.

In the F&P Chlorinator a simple series of hand manipulations tests each safety component—or shows the reason for malfunctioning should it ever occur.

These safety advantages are yours in the Fischer & Porter Chlorinator. They cost you not one penny more at the outset, since the F&P Chlorinator is lower in first cost. They avoid constant costs of repeated safety tests and checks. They assure you against high costs of repairs and maintenance. We don't put our safety devices under a bell jar—they are right out in the open where you can see and touch them.

These engineered features—*instrument-type engineering*—make the F&P Chlorinator the safest ever built. And you get all these safety features *plus* ease of operation, dependability proven in over 600 operating units, complete corrosion resistance—everything you should have in a chlorinator—and you get them for even less cost in the initial purchase. Write today for full information, details on free trial offer, and *absolute guarantee of satisfaction*.

complete process instrumentation

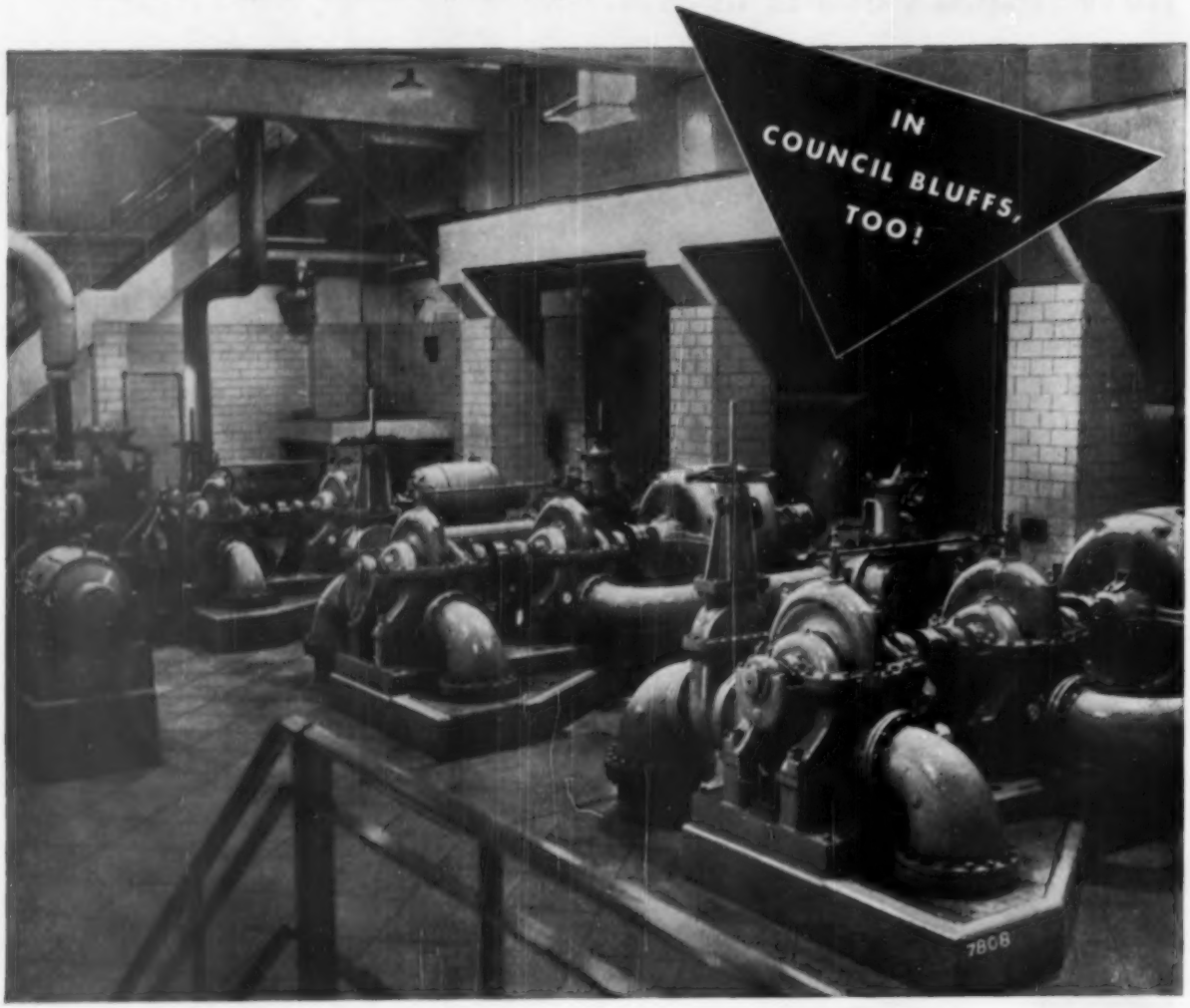
FISCHER & PORTER CO.

115 Fischer Road Hatboro, Pa.

FP

18 YEARS SUCCESSFULLY MANUFACTURING CHLORINE CONTROL EQUIPMENT

DE LAVAL pumps America's water...



In Council Bluffs, Iowa, as in more than 80% of America's municipal stations, De Laval centrifugal pumps are faithful public servants.

On the line are two motor-driven De Laval 14/12 units. Each unit has two pumps in series designed for 4,500 gpm against a total head of 245 feet at 1,200 rpm. Another pumping unit, dual driven by a gas engine at one end and a motor at the other, consists of two De Laval 12/10 pumps in series. Operating conditions for these are 3,750 gpm against a head of 235 feet at 1,200 rpm.

Fifty-three years experience in pump building, during which time De Laval has introduced numerous "firsts" in pump design, is the reason for this nation-wide preference.

NOTE:

Have you considered the dollars and cents savings you can make by replacing your old pumps with new, more efficient De Laval units? Write to De Laval for Pump Fax bulletin which includes a valuable "power savings" chart.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY

824 Nottingham Way, Trenton 2, New Jersey

DL 260

Grandpa thought he was saving money...

"Yes, dear, 25 years ago grandpa was on the Water Board when they ran the pipe line out Madison Street to Western Heights. Grandpa and the other members voted to buy a substitute for cast iron pipe—they thought they were saving money. Now this pipe has failed entirely after years of expensive maintenance caused by breaks and leaks.

"Tonight we're letting a contract to replace that pipe. As Water Board chairman, I'm going to recommend the purchase of Clow Cast Iron Pipe—a pipe with a *proven* record of long service and low maintenance expense. It might cost a little more now than substitutes do, but it will be much less expensive in the long run. You might say that cast iron pipe is the taxpayer's friend—and Clow centrifugally cast pipe is the most economical of all. What's more, we've talked to other waterworks officials and Clow has a wonderful reputation for consistent high quality and excellent service."

Clow Cast Iron Pipe meets all currently approved specifications now in existence. Write today for factual information and case histories on Clow's 75-year-old reputation for economy.

JAMES B. CLOW & SONS

201-299 N. Talman Ave. • Chicago 80, Illinois

Subsidiaries: Eddy Valve Co., Waterford, N.Y.
Iowa Valve Co., Oskaloosa, Iowa

CAST IRON

HANDLING 11,000,000 GALLONS PER DAY, the new sewage plant at Salem, Oregon, has Worthington pumps for continuous, economical pumping power. John W. Cunningham & Associates, Portland, Oregon, were the Consulting Engineers for this project.

Salem's sewage system relies on these pumps

". . . since the day our plant opened in 1952, Worthington pumps have been in daily operation — with never a breakdown. And because these pumps are the very life-line of our plant, their reliability has proved invaluable."

That's what Chief Operator Cliff Reed says about the eight Worthington centrifugal pumps at work in the new sewage disposal plant serving Salem, Oregon.

Mr. Reed isn't alone in his opinion about the rugged Worthington units. We've had similar reports wherever Worthington pumps, comminutors or engines have been used — and that means water works and sewage plants all over the world.

Helping municipalities with their sewage and water works problems is our job today — has been for over 100 years. Write today for Bulletin W-317-B16 to Worthington Corporation, Public Works Division, Harrison, New Jersey. W.4.11

SEE the Worthington Corporation Exhibit in New York City. A lively, informative display of product developments for industry, business and the home. Park Avenue and 41st Street.

WORTHINGTON

ALL MAJOR PUBLIC WORKS EQUIPMENT UNDER ONE RESPONSIBILITY

Water Works Pumps • Sewage Pumps • Comminutors • Vertical Turbine Pumps • Vacuum Pumps

Ore and Coal Mines

Coke Ovens

Blast Furnaces

Pipe Plants

our integrated operation means undivided control of quality

U.S. cast iron PIPE

FOR WATER, GAS, SPECIALTIES AND INDUSTRIAL SERVICE

We are a wholly integrated pipe-producing unit — with mines, quarries, blast furnaces and laboratories under one direction and control.

What does this mean to you, a pipe buyer? It means that we are in the best possible position to take *complete* and undivided responsibility for the quality of our product . . . from raw materials to finished pipe.

In addition to being able to control the quality of pipe-making raw materials at their sources, our Quality Control of pipe production gives further assurance to customers that the quality level of U. S. Cast Iron Pipe is in excess of standard specifications. Our pipe is produced to *our own* quality control specifications, more exacting than the established specifications under which cast iron pipe is normally purchased.

U. S. PIPE & FOUNDRY COMPANY

GENERAL OFFICES: BIRMINGHAM 2, ALABAMA

A wholly integrated producer . . . from mines and blast furnaces to finished pipe.

OVER 300 MUNICIPALITIES USE ACCELATOR® Treating Plants

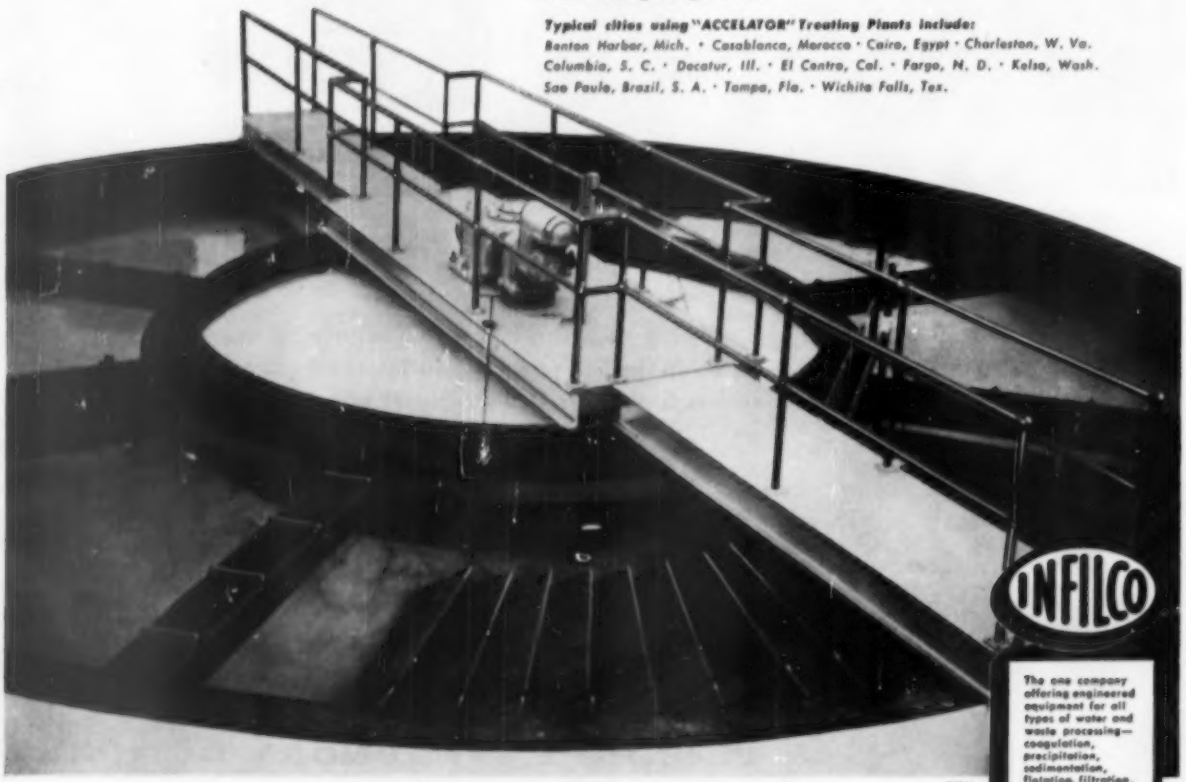
...for less space...for less cost
...for better results

Combining mixing, coagulation and solids separation in a single unit, "ACCELATOR" plants have a proven record for flexibility, uniformly good effluent, ease of operation and chemical economy. By using the principle of slurry recirculation and dynamic separation, "ACCELATOR" plants soften, stabilize and clarify water at consistently higher rates. This means more capacity from smaller units and substantial savings in construction and operating costs. In addition "ACCELATOR" treating plants produce better water. Tests have shown over 99% removal of bacteria and algae, as well as more complete removal of turbidity, color, iron and hardness.

Present installations are delivering from 15,000 to 75,000,000 gallons per day. Units can be engineered for any capacity to meet your requirements. These and many other advantages are reasons why it will pay to install an "ACCELATOR" plant to serve your community.

Write for complete catalog information or see your Consulting Engineer.

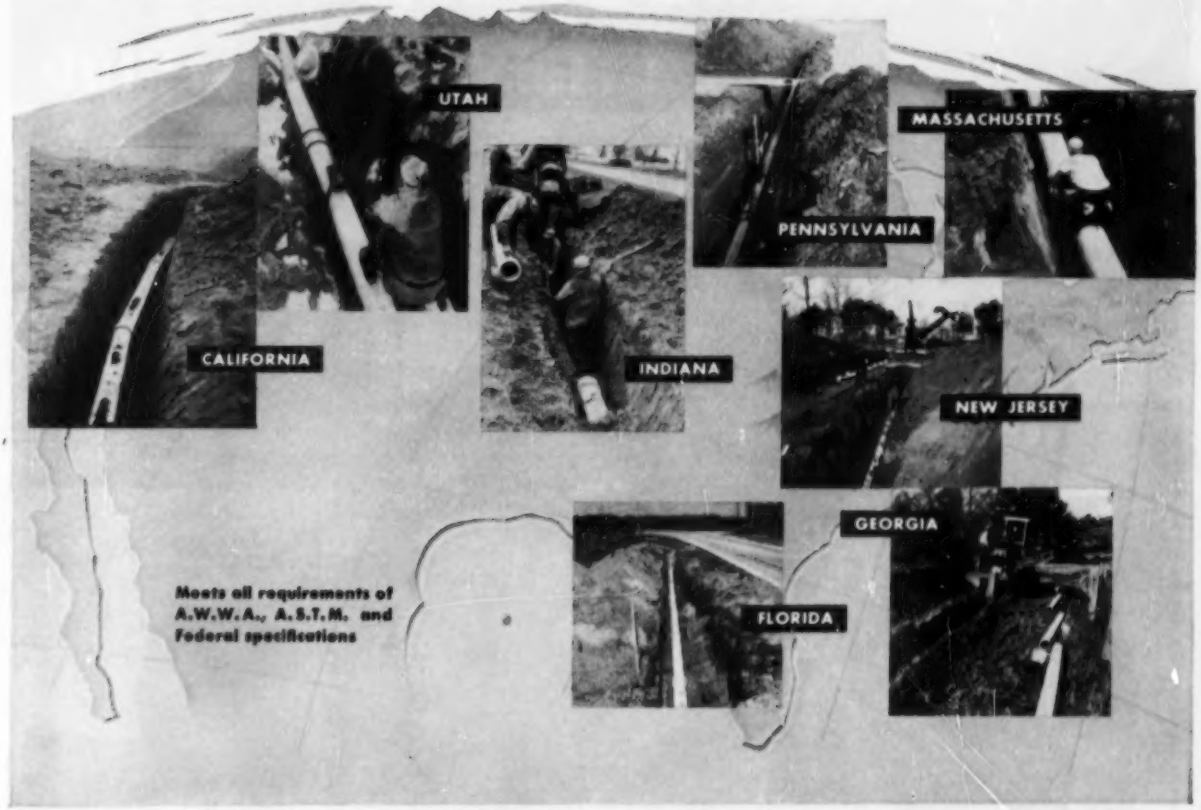
Typical cities using "ACCELATOR" Treating Plants include:
Benton Harbor, Mich. • Casablanca, Morocco • Cairo, Egypt • Charleston, W. Va. Columbia, S. C. • Decatur, Ill. • El Centro, Cal. • Fargo, N. D. • Kelso, Wash. Sao Paulo, Brazil, S. A. • Tampa, Fla. • Wichita Falls, Tex.


INFILCO
The one company offering engineered equipment for all types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment.

5524

INFILCO INC. 923 South Campbell Ave. Tucson, Arizona
Field offices in principal cities in North America

Setting new standards—everywhere...



Transite Pressure Pipe and Ring-Tite Coupling speed water line assembly, lower installation cost

IN COMMUNITY after community, proof that Transite® Pressure Pipe and Ring-Tite® Coupling speed water line assembly and cut installation costs is reflected in such contractor comments as these:

"Exceeded by far, the speed anticipated under job conditions."

"Based bid on 400 feet a day, actually laid over 700 feet."

"Established an entirely new concept of installation savings."

These new records for speedy installation have been accomplished despite adverse terrain, weather conditions and the presence of muck and mud in many of these locations. That is why, whatever your water line problem it will pay you to learn all about Transite's many advantages.

* * *

Write for the new Transite Brochure, TR-142-A, Johns-Manville, Box 60, New York 16, N. Y.

Johns-Manville TRANSITE PRESSURE PIPE

THE ASBESTOS CEMENT PIPE WITH THE NEW RING-TITE COUPLING

THE MEMBERSHIP OF A
C.I.P. Century Club

96%

OF ALL 6-INCH AND LARGER CAST IRON WATER MAINS EVER LAID IN 25 REPRESENTATIVE CITIES ARE STILL IN SERVICE.

Based on the findings of a survey conducted by leading water works engineers.

CAST IRON PIPE

DISTINGUISHED CLUB...
now has 67 Members!

The Cast Iron Pipe Century Club is probably the most unusual club in the world. Membership is limited to municipal, or privately-owned, water and gas supply systems having cast iron mains in service for a century or more. Although the Club is formally constituted, there are no dues, no regular meetings, and no obligations other than to inform the Recording Secretary if and when the qualifying water or gas main is taken out of service, or, sold for re-use.

In spite of the unique requirements for membership, the Club roster grows, year by year, from 18 in 1947 to 67 in 1954. Members comprise 35 *water* and 32 *gas* utilities, in cities large and small, from the Pacific to the Atlantic, from Canada to the Gulf.

If your records show a cast iron main in service, laid a century or more ago, the Club invites you to send for a handsome framed Certificate of Honorary Membership. Address Thomas F. Wolfe, Recording Secretary, Cast Iron Pipe Century Club, Peoples Gas Bldg., Chicago 3, Illinois.

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NIAGARA MOHAWK POWER CORP. (GAS)
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ALEXANDRIA WATER COMPANY
Alexandria, Virginia
BUREAU OF WATER, DEPT. OF PUBLIC WORKS
Baltimore, Maryland
CONSOLIDATED GAS ELECTRIC LIGHT AND POWER CO.
Baltimore, Maryland
PUBLIC WORKS DEPT., WATER DIVISION
Boston, Massachusetts
BOSTON CONSOLIDATED GAS CO.
Boston, Massachusetts
PUBLIC SERVICE ELECTRIC & GAS CO.
Bound Brook, New Jersey
BRIDGEPORT GAS LIGHT COMPANY
Bridgeport, Connecticut
DEPARTMENT OF PUBLIC WORKS, DIVISION OF WATER
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Charleston, South Carolina
PEOPLES GAS LIGHT & COKE COMPANY
Chicago, Illinois
WATER WORKS DEPARTMENT
Chicago, Illinois
*CINCINNATI GAS & ELECTRIC CO.
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*FREDERICK GAS COMPANY, INC.
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THE HARTFORD GAS COMPANY
Hartford, Connecticut
*WATER BUREAU OF THE METROPOLITAN DISTRICT
Hartford, Connecticut
MUNICIPAL WATER WORKS
Huntsville, Alabama
*CITIZENS GAS & COKE UTILITY
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BUREAU OF WATER
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CITY OF LYNCHBURG WATER DEPARTMENT
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NEW ORLEANS PUBLIC SERVICE, INC. (gas)
New Orleans, Louisiana
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PROVIDENCE GAS COMPANY
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YORK WATER COMPANY
York, Pennsylvania
WATER DEPARTMENT City of Zanesville, Ohio

*New Members in 1954

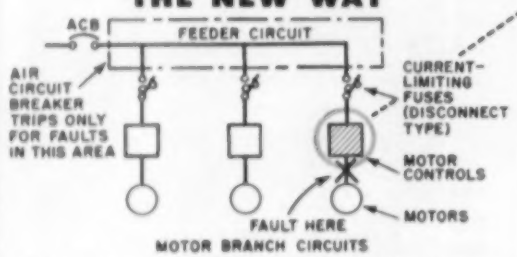
SERVES FOR CENTURIES

NOW... low-cost short-circuit protection for large, low-voltage motors with E-M HI-FUSE LOW-VOLTAGE CONTROL!

● This simplified E-M Control, lower in cost than equivalent circuit breaker protection, brings to users of low-voltage motors an impressive series of advantages:

1. **HIGH INTERRUPTING CAPACITY**... 100,000 rms ampere interrupting capacity, plenty for future expansion as well.
2. **CURRENT-LIMITING**... disconnect type fuses minimize magnetic and thermal stresses on control components.
3. **FAST ACTING**... faults are interrupted in ½ cycle or less; 100% availability with no adjustments needed.
4. **COORDINATED PROTECTION**... includes fuse interruption on short circuits and overload relay trip on normal overloads.
5. **"BULL'S EYE" SELECTION**... only the faulted circuit is interrupted. See diagram below.
6. **MINIMUM MAINTENANCE**... there is nothing to wear out. Only occasional routine inspection required.

THE NEW WAY



MOTOR BRANCH CIRCUITS

When you have E-M Hi-Fuse, Low-Voltage Control on duty, you don't need to depend on a feeder circuit breaker, which would shut down all motors to clear a motor branch circuit fault. Instead, fuses in the E-M Control safeguard each branch circuit, clearing faults almost instantly while other motors continue in service.

One low-cost integrated unit!

E-M "pre-engineers" control components, arranging them together simply and effectively in one compact enclosure. You get complete, unified, dependable protection for motor and personnel at low cost! Ask your nearest E-M sales engineer for further information, and write the factory for Publication No. 218.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

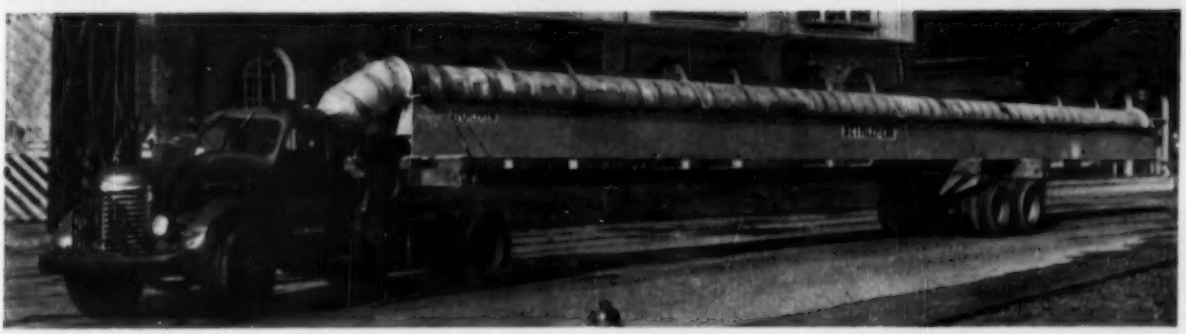
E-M 3300-TPA-2177

Specialists in **PROTECTIVE CONTROLS FOR ELECTRIC MOTORS**

Bethlehem Steel Pipe On The Job

IN FORT SMITH, ARK. — Nearly 12,000 feet of 22-inch Bethlehem Tar-Enameled Pipe was used in the new feeder main that supplies a fast-growing section of Fort Smith.

NEAR DECATUR, GA. — Laying well over four miles of 30-inch coated and wrapped Bethlehem Steel Pipe. The 40-foot lengths were joined by mechanical couplings.



PHILADELPHIA, PA. — Shown being trucked from our Steelton, Pa., fabricating works, this all-welded H-Beam pipe bridge will span a railroad right-of-way in suburban Philadelphia. The pipe is 24 in. ID; the bridge is 83 ft long between field seams.

The list of municipalities using Bethlehem Tar-Enameled Steel Pipe is long — and getting longer all the time. It includes New Orleans, Cincinnati, Minneapolis, New York, Duluth, Washington, Omaha, Wilkinsburg, Pa., Bay City, Mich., Winston-Salem, N. C., and Colorado Springs, Colo.

When you're in the market for a new water or sewage line, we suggest that you consider the many advantages of Bethlehem Tar-Enameled Steel Pipe. It has the great strength, shock-resistance and freedom from leaks that only steel pipe can offer. What's more, its smooth, uniform coating of coal-tar enamel resists corrosion and incrustation, ensures a high rate of flow year after year. Available in 40-ft lengths, and in all diameters from 18 in. ID to the largest permitted by common carriers.

If you'd like more information, phone or write the Bethlehem sales office nearest you.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM *Tar-Enameled* STEEL PIPE

The Safest Meters to Buy are AMERICAN

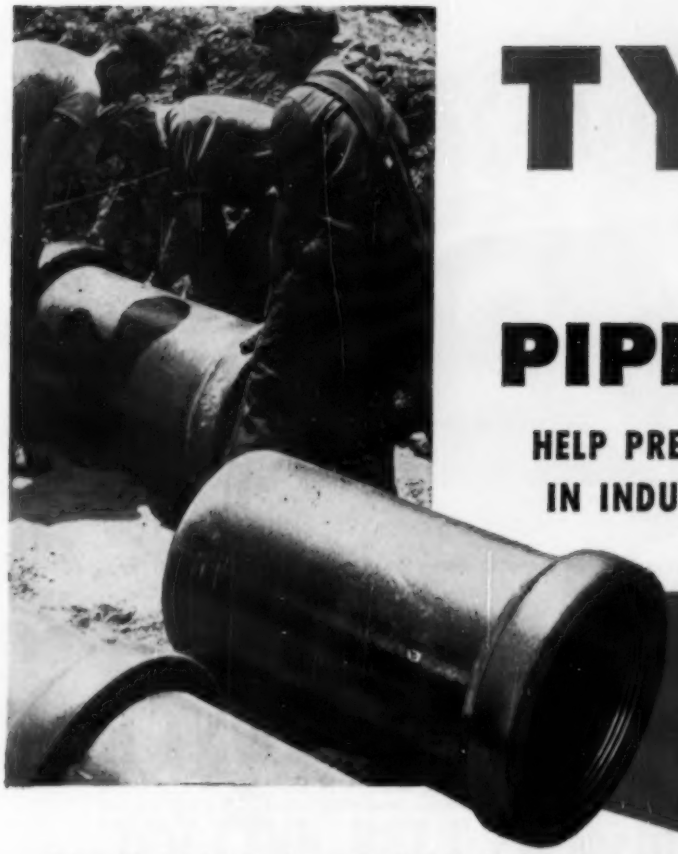
Because:
they're so easy to maintain

"American Meters reduce work in the meter shop because they are built so well and so simply there's hardly any maintenance. That's why we play safe and buy American."

American Meters everywhere are proving their built-in quality by operating so free of trouble year after year. Work in the meter shop is made easier. Individual parts are interchangeable in old or new meters. Yes, the repairman who knows, endorses American, the safest meter to buy.

BUFFALO METER CO.

2909 MAIN STREET • BUFFALO 14, N. Y.



TYLOX
Rubber
PIPE GASKETS

HELP PREVENT PIPE LINE FAILURES IN INDUSTRIAL WASTE DISPOSAL

That's why engineers and officials specified TYLOX-Jointed waste lines for the Ford Motor Company's new plant at Monroe, Michigan

When Consulting Engineers Hubbel, Roth & Clark wrote "TYLOX Rubber Joints" into the Ford Plant's waste disposal specifications, in three brief words they assured success for the project in the three most important factors of industrial sewerage and drainage pipe work. Here's why:

TYLOX IS CORROSION PROOF — Destructive acid action works overtime in industrial sewers, but can't harm TYLOX Joints. They're made of acid and alkali-resistant rubber which safely handles corrosive wastes.

TYLOX IS LEAK PROOF — *Multiple* sealing surfaces, all under compression, keep waste water in, and ground water, roots and sediment *out* of the pipe. No infiltration . . . no exfiltration with TYLOX; therefore no costly line failures resulting from either.

TYLOX IS FLEXIBLE — Shock loads . . . heavy overburdens . . . deep fills . . . all acute factors in industrial areas, can't rupture the TYLOX *compression* seal.

These TYLOX advantages, *plus* their cost-saving speed of installation and long life (they outlast the pipe itself) are why leading engineers are regularly specifying TYLOX for big and little pipe jobs the world over. Specify TYLOX RUBBER JOINTS to protect *your* next pipe project from the troubles and cost of joint failures.

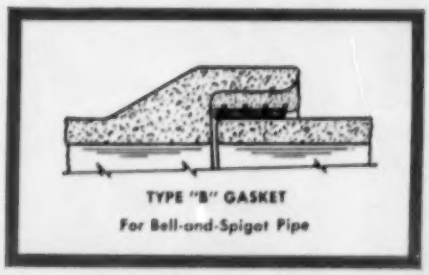
Write today for complete specification data and literature on TYLOX Rubber Pipe Joints

PROJECT: *Ford Motor Company — Treatment Plant at Monroe, Michigan*

ENGINEERS: *Hubbel, Roth & Clark, Detroit, Michigan*

PIPE: *Vitrified Clay with integrally cast TYLOX Rubber Joints. Manufactured by Universal Sewer Pipe Corporation, Cleveland, Ohio*

CONTRACTORS: *Robert Carter Company, Toledo, Ohio*



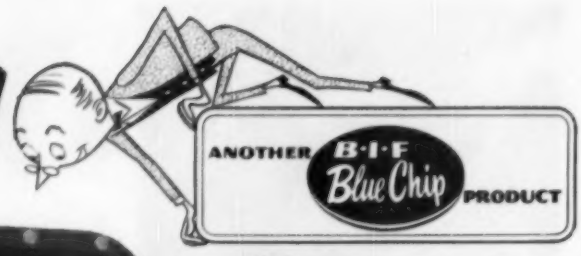
TYPE "B" GASKET
For Bell-and-Spigot Pipe

This rubber-tight mechanical seal stays tight "for the life of the line."

1952

HAMILTON KENT MANUFACTURING CO.
427 W. Grant St. KENT, OHIO ORchard 3-4555

What a Meter for Water!



ANOTHER B·I·F Blue Chip PRODUCT

BUILDERS PROPELOFLO is an inexpensive main line meter for totalizing water consumption. Gives dependable, trouble-free service on the job. Meters accurately over wide range — six-digit totalizer shows water use directly in gallons, cubic feet, etc. For complete information on this easy-to-install meter, write to Builders-Providence, Inc., 350 Harris Ave., Providence 1, Rhode Island.

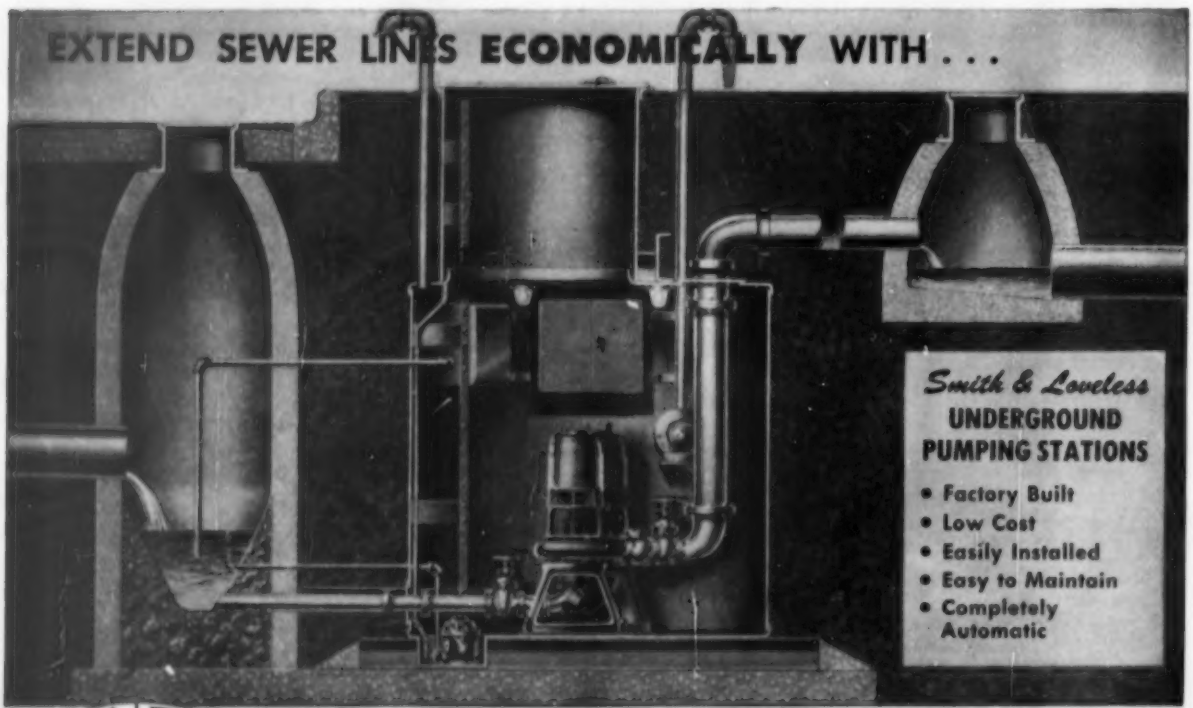
BUILDERS-PROVIDENCE

DIVISION OF B·I·F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

BIF METERS FEEDERS CONTROLS

EXTEND SEWER LINES ECONOMICALLY WITH . . .



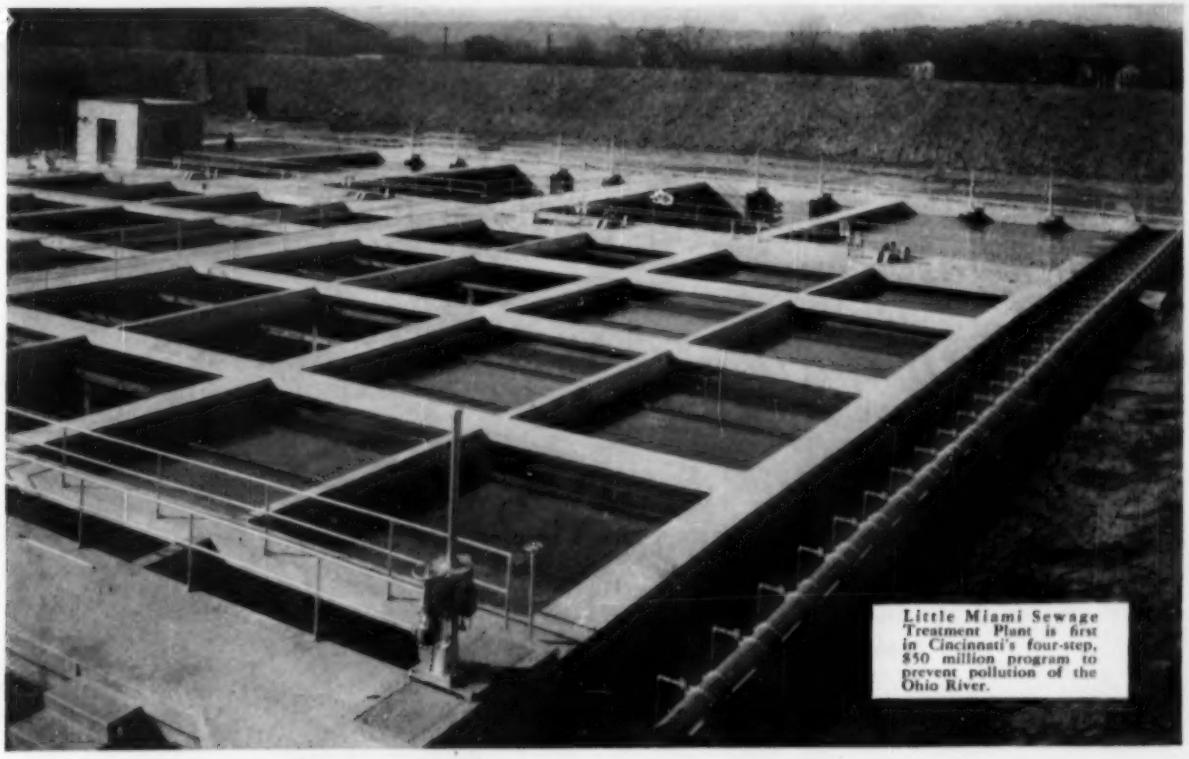
Smith & Loveless
UNDERGROUND PUMPING STATIONS

- Factory Built
- Low Cost
- Easily Installed
- Easy to Maintain
- Completely Automatic

S&L *Smith & Loveless, Inc.*

Write for your free copy of our Engineering Data Manual, containing full details on Smith & Loveless Pumping stations.

P. O. BOX 8172, KANSAS CITY, MO., Plant, MERRIAM, KANSAS



Little Miami Sewage Treatment Plant is first in Cincinnati's four-step, $50 million program to prevent pollution of the Ohio River.

It's LINK-BELT collectors and mixers at Cincinnati's new sewage treatment plant

BECAUSE the 900-mile Ohio River is the water supply as well as waste outlet for many communities in the eight states bordering it, Cincinnati's sewage disposal problems had to be resolved with consideration for downstream cities. Havens and Emerson, Cleveland consulting engineers, chose Link-Belt mixing-settling equipment.

The outcome: a treatment system designed for almost complete removal of settleable solids . . . 45 per cent removal of total suspended solids, estimated at 250 parts per million . . . 65 per cent B.O.D. reduction of raw sewage with 270 parts per million. While present flow is 18 mgd, actual capacity is 29 mgd, expected to be reached about 1980.

In both breadth of equipment line and depth of experience, Link-Belt is well qualified to handle your sewage treatment requirements—be they large or small. Our sanitary engineers will be glad to work with your engineers, chemists and consultants to provide the finest in modern water, sewage or industrial liquids treatment.

Link-Belt Straightline mixers and collectors in flocculation compartment (foreground) combine to provide maximum solids removal in shortest time. Link-Belt 30 and 48-in. belt conveyors are also used in processing sludge.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13.640

"Financial Security Is Based On Savings . . ."

ARTHUR B. HOMER
President
Bethlehem Steel Corporation

". . . and the purchase of U.S. Savings Bonds through the Payroll Savings Plan is one of the easiest ways for any individual to save for economic security."

If you agree with Mr. Homer that ". . . the Payroll Savings Plan is one of the easiest ways to save for economic security."—

If you believe with millions of other Americans that there is no safer investment than U.S. Savings Bonds—

Why not take a *really personal* interest in your employees and your Payroll Savings Plan?

Pick up the phone, now, and ask the man in charge of your Payroll Savings Plan three questions:

- How many of your employees are enrolled in the Payroll Savings Plan?
- What is the percentage of employee participation?
- When did your company last conduct a person-to-person canvass?

If less than 50% of your employees are enrolled in the Plan . . . if you have not conducted a person-to-person canvass in the past two years *(or if you do not have the Plan)*, act now! Telephone, wire or write to Savings Bonds Division, U.S. Treasury Department, Washington, D. C. You will hear promptly from your State Director, U.S. Treasury Department who will be glad to help you conduct a person-to-person canvass that will put an application blank in the hands of every employee. That is all you have to do. Your employees will do the rest. They want to save for their economic security.

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and Water & Sewage Works

PITTCHLOR®

...way ahead...all ways!

Pittchlor, the high-test calcium hypochlorite containing a minimum of 70% available chlorine, has proved itself outstanding in every application around water works and sewage plants. It is excellent for chlorinating water supplies, treating sewage, and wherever the germicidal or deodorizing effects of chlorine are required.

★ **QUALITY.** Manufactured to exacting standards, you can be certain Columbia-Southern® Pittchlor is of consistent top quality and good stability.

★ **EXPERIENCE.** Columbia-Southern has been producing chemicals for over half a century. Personnel are carefully selected and trained.

★ **UNIFORMITY.** Rigid production control in Columbia-Southern's Pittchlor plant at Barberton, Ohio, assures uniform chemical and physical characteristics.

★ **SERVICE.** Distributors have been selected for their alertness, progressiveness, and good service. There is one located near you.

★ **PACKAGING.** Pittchlor packaging (3¼ lb. non-resealable can, 5 lb. resealable can, 100 lb. and 130 lb. steel drums with fully removable heads) allows you to select the container best suited to your needs.

SEE YOUR DISTRIBUTOR NOW!

COLUMBIA-SOUTHERN CHEMICAL CORPORATION
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DISTRICT OFFICES: Cincinnati • Charlotte
Chicago • Cleveland • Boston • New York
St. Louis • Minneapolis • New Orleans
Dallas • Houston • Pittsburgh • Philadelphia
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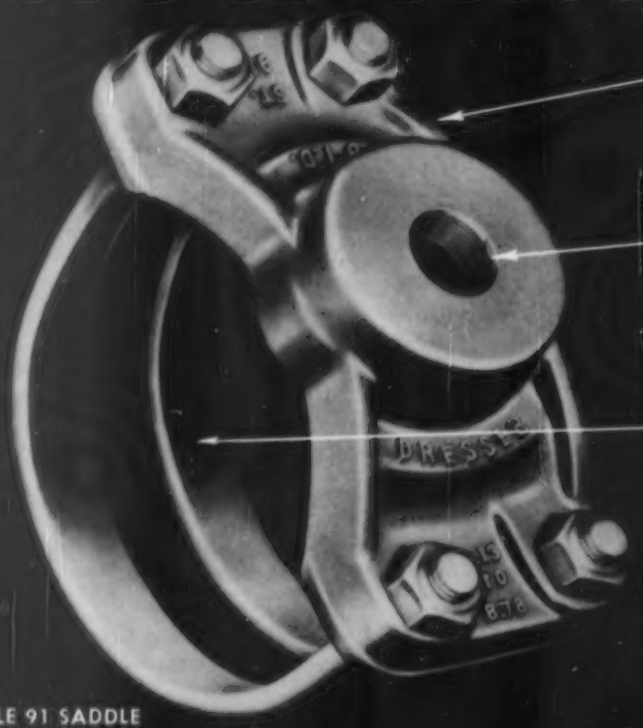
NOW AVAILABLE



STYLE 91 SADDLE
(8" ID)

HEAVIER CONSTRUCTION
Bodies designed with heavily reinforced sections, ruggedly constructed from Grade A malleable iron.

FULL TAPPING RANGE
Available with Corporation Stop Thread or IPS Thread taps to 2 inches in size. Large boss insures full threads.

FLAT STEEL STRAPS
Accurately shaped, high tensile steel straps conform to pipe. Wide, flat surfaces prevent cutting or crushing.

FITS RANGE OF PIPE
Fits steel, cast iron and asbestos-cement pipe within size range clearly marked on each saddle.

NEW DRESSER SERVICE SADDLE

...designed for long, rugged service

The new Dresser Style 91 Service Saddle has been carefully designed for maximum dependability, economy and ease in making service connections.

The body of the saddle is heavily constructed with a Dresser gasket of time-proven Grade 27 compound securely cemented in place. Cold-rolled threads give the bolts greater strength and added resistance to corrosion.

Style 91 Saddles are heavily galvanized or protected with Dresser's new plastic dip. This coating covers all threads as well as saddle surfaces, has dielectric strength, will not "plate out". Saddles are packaged for convenient handling and storage.

Order a stock of Dresser's new, economical Style 91 Saddles from your local waterworks supplier today, or write us!

DRESSER®

Dresser Manufacturing Division, 69 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston; 101 S. Airport Blvd., S. San Francisco. Sales Offices also in: New York, Philadelphia, Chicago, Toronto.

WHICH WILL IT BE...

a little more NOW—or a lot more LATER?

Let's take a close look at this so-called higher cost of wrought iron pipe.

All too often, INITIAL COSTS are used as the only basis of comparison. The fallacy of the initial-cost-yardstick has been proved time and time again in installations where low-first-cost piping has been installed and has failed prematurely. The original installation was quickly made by pipe fitters. But repairs call for hours of work by as many as five craftsmen—pipe fitters, masons, carpenters, plasterers, painters. And labor costs are only part of the picture. The indirect costs of production slowdowns and disrupted routine swell the total of every premature pipe failure. It's easy to see how this first failure can wipe out initial "savings" many times over.

The only *valid comparison* of piping costs is INSTALLED COSTS *plus* REPAIRS. This yardstick places the emphasis where it rightly belongs . . . on SERVICE LIFE. In installation after installation, wrought iron pipe has doubled, tripled and even quadrupled the useful service life previously obtained from low-first-cost piping. All this adds up to one thing . . . the fact that you pay a little more for wrought iron means that you pay a LOT LESS FOR MAINTENANCE. Wrought iron gives you *piping economy,* because it lasts longer, at lower cost per year!

If you are concerned about piping services where corrosion is a threat to durability, you'll find it profitable to investigate the longer life of wrought iron pipe. Our Engineering Service Department will be happy to send you examples of typical wrought iron service records in installations similar to those in which you are interested. Write or call.

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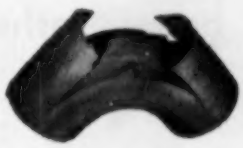

Why Genuine Wrought Iron Lasts

This notch-fracture test specimen illustrates the unique fibrous structure of wrought iron—which is responsible for the high corrosion resistance of the material. Tiny threads of glasslike silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

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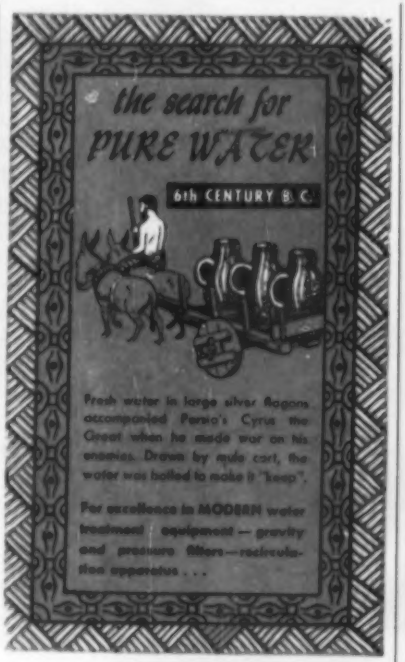
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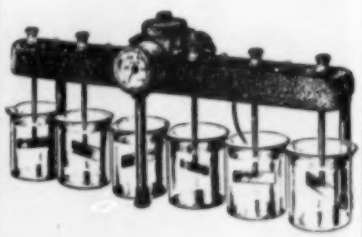

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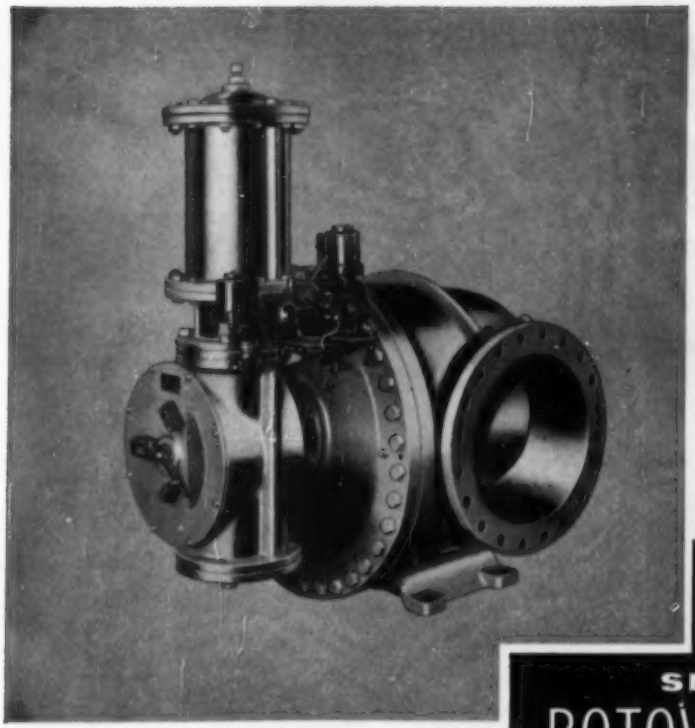

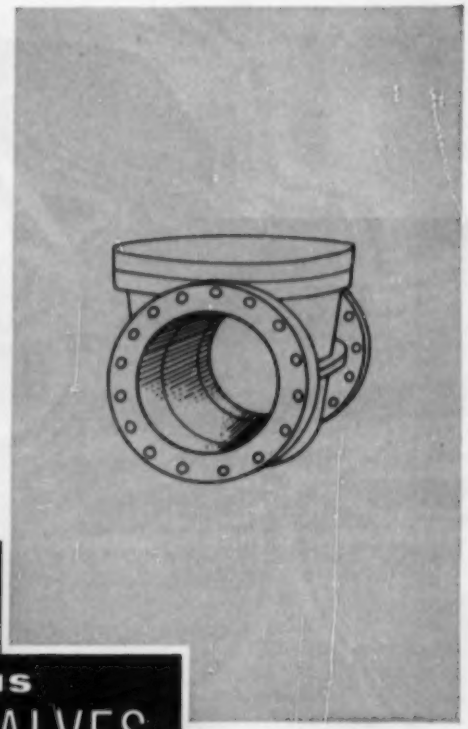

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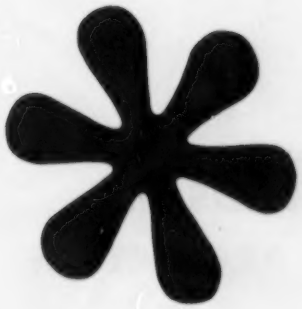

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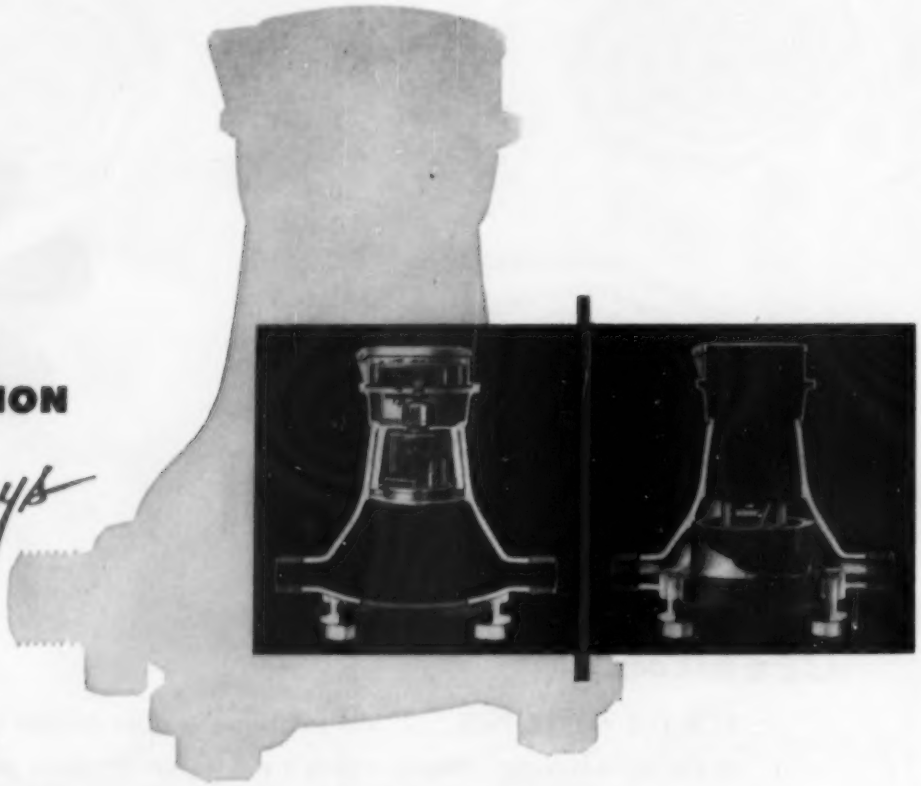

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WATER & SEWAGE WORKS
A Scranton-Gillette Publication JANUARY, 1955

Chicago Bridge & Iron Co. Photo

WATER STORAGE—New Horton cone-roof reservoirs, 100-ft. diameter by 50-ft. high, serve Yuma, Arizona

Water Supply Progress in 1954

by DALE L. MAFFITT

Mr. Maffitt is General Manager of the Water Works, Des Moines, Iowa. He has twice been a Director of the A.W.W.A., was Fuller Award recipient in 1949, became Vice-President of the Association in '53, and was elected President in 1954.

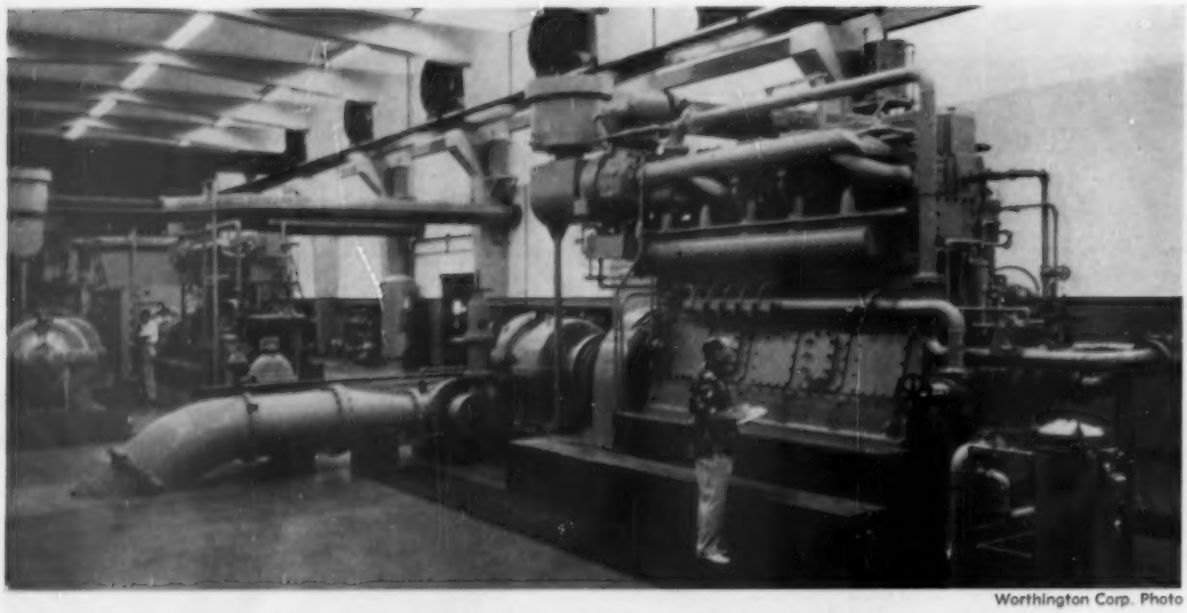
THE INDUSTRIAL expansion and population growth of the United States continue to require increased water supply, and the water works business is responding to that demand. We can predict, with considerable accuracy, the growing need for water which these factors will cause within the foreseeable future.

It is more difficult, however, to anticipate the ultimate effects of steps taken during 1954 to advance the industrial development of atomic power. This is a development likely to bring about a greater change in our methods of water supply protection, as well as in our source of power for pumping, than any other basic change this country has ever experienced. The possibilities are great, and the water works industry will benefit, along with other fields of endeavor, as this awe-inspiring discovery of science is diverted to peaceful pursuits. Our industry is alert to the dangers, as well as the possibilities, of this development.

Atomic Power and Water Pollution

The United States Congress in August, 1954, passed a law which authorized the Atomic Energy Commission to issue licenses, under certain rigid federal regulations, for private industry to construct nuclear power reactors. The objective of this law is to bring industry into atomic power development on a proprietary basis. At the time of this writing not a single company has asked the Atomic Energy Commission for a license to start its own atomic power project. However, the way is open, and it will be only a matter of time until some organization is ready to venture into this new field.

The water works industry is concerned with the problem of controlling



Worthington Corp. Photo

DIESEL POWER—Four supercharged 825 hp engines drive four 15-mgd pumps in City of Miami, Fla., pumping station

the pollution of water by radioactive wastes, and the American Water Works Assn. Committee on National Water Policy under Abel Wolman has a Task Group working on Instrumentation Methods of Testing Radioactive Contamination in Water. These methods will be needed: when private industry builds reactor installations for power production, the disposal of atomic wastes, if not properly controlled, can result in serious water pollution.

A five-day International Congress on Nuclear Engineering, sponsored by the Nuclear Engineering Division of the American Institute of Chemical Engineers, was held at the University of Michigan, June 21-25, 1954. A speaker from the Argonne National Laboratory pointed out that dangerous radioactive waste products of nuclear power plants give this generation a serious responsibility to future generations. "Even the oceans are not big enough to hold the radioactivity which may conceivably be produced," he said. The problem of final disposal will not be changed by use of fission-product wastes for industrial purposes, but that use may offer the advantage of reduction in bulk of the waste products and help to pay some of the cost of final disposal. Diluting the wastes in large volumes of water or air has merit as long as the waste quantities remain small, but this procedure will not solve the problem of future waste quantities.

Two possible methods of disposing of radioactive waste products were described by scientists from Brookhaven National Laboratory. One method involves evaporating the waste to dryness and fusing it into a solid mass, all within disposable containers. The second method involves absorption of fission products ions on clay and the fixation of these ions by heating the clay to high temperature. It was reported that current disposal methods which involve liquid storage in large underground tanks is clearly inadequate for any future reactor sites in populated areas, and is, in fact, inadequate as a permanent disposal method even for Atomic Energy Commission sites in vast uninhabited localities.

In June, 1954, Harry E. Jordan, Secretary of the A.W.W.A., and Abel Wolman, Chairman of the Association's committee on National Water Policy, filed a statement with the Water Resources and Power Task Group (Hoover Commission). The statement recommended that there be included in the Act a definite stipulation that industrial users of nuclear reactors be subject to the water pollution control authority of the United States Public Health Service at the national level; and, to the authority of the responsible agencies in the various states or groups of states, whenever water allocation or water pollution control is an intra-state problem. The A.W.W.A. statement was prepared with approval of the Association's Board of Directors. At present the Association is organizing future participation in cooperation with the Conference of State Sanitary Engineers, the Federation of Sewage and Industrial Wastes Assns., and the Water and Sewage Works Manufacturers Assn.

The 1954 Atomic Energy Law relating to water rights and water pollution is not specific. The officials of the American Water Works Assn. are continuing their efforts to amend the law—to the end that it include a simple, definite statement recognizing the authority of the United States Public Health Service and the various state agencies to control water use and water pollution derived from nuclear reactor wastes.

The Engineers Joint Council And National Water Policy

The Engineers Joint Council is a federation of eight major engineering organizations of the United States. One of its objectives is to provide a medium for a coordinated expression of the views of a majority of the engineering profession upon national problems invested with an engineering interest. At present Engineers Joint Council is comprised from representatives from the governing boards of the following societies having a combined membership of about 170,000 engineers: American Society of Civil Engineers, American Society of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers; American Institute of Chemical Engineers, American Water Works Association, Society of Naval Architects and Marine Engineers, and American Society for En-

gineering Education.

In 1947, Engineers Joint Council established a National Water Policy Panel. The Panel was authorized to take such action as might be necessary to formulate, and in due time to present to Congress, proposals intended to result in the establishment of a sound national water policy. In July, 1951, the printed report which developed from this study was issued under the title, "Principles of a Sound National Water Policy," and copies were sent to each member of Congress.

On June 29, 1954, the Engineers Joint Council submitted a statement to the Subcommittee on Irrigation and Reclamation of the Senate Committee on Interior and Insular Affairs regarding the proposed authorization of the Colorado River Storage Project and participating projects (S. 1555).

The Engineers Joint Council (operating through its National Water Policy Board) does not concern itself with the merits of any given water resources project as such. Rather, it is primarily concerned with the broad principles and policies involved.

In July, 1953, by Act of Congress, there was set up a bi-partisan Commission on Organization of the Executive Branch of the Government, headed by ex-President Hoover, and commonly referred to as "The Hoover Commission." The enabling legislation is understood to imply that the Commission investigate, among other things, this matter of water resources policy.

It was the viewpoint of the Engineers Joint Council that the bill for comprehensive development of the Upper Colorado River Basin was exceedingly important because of principles and policies contained in the bill which might be influential, if not controlling, in their effect upon future projects.

The recommendation of the Engineers Joint Council to the Congressional Committee included the following statement: "In view of the foregoing facts and considerations, Engineers Joint Council respectfully submits that it will be logical and for the best interest of the country if the Congress refrain from authorizing the Colorado River Storage Project and other large or costly water resources projects until after the Hoover Commission has had opportunity to complete its current studies and to submit its pertinent recommendations to the Congress." [Ed. note: This bill did not pass.]

Carborundum Co. Photo

NEW FILTRATION PLANT—Porous plate underdrains are feature of filters in 40-mgd Niagara Falls, N. Y., water treatment plant. The old plant is almost equal in capacity.

A. M. Byers Co. Photo

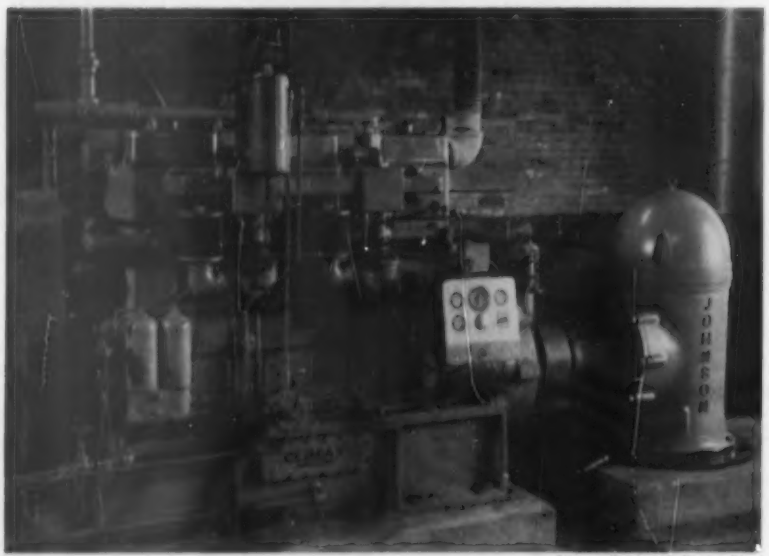
PLANT UNDER CONSTRUCTION—New water filtration plant being built for the City of Warren, Ohio, uses wrought iron pipe in many corrosion-protection applications.

American Locomotive Co. Photo

NEW SETTLING BASINS—An 883-ft. loop of electric-welded steel pipe, serves six settling basins. These are part of 105-mgd capacity increase planned by Kansas City, Mo.

American Well Works Photo

MIXING UNITS—Three 24-in. Homomix units, each 10,000-gpm capacity, installed ahead of coagulation unit in the Savannah, Ga., water treatment plant.



Climax Engine & Pump Photo

EMERGENCY STANDBY SERVICE—One of two units at Paducah, Ky., water works. This 124-hp, 6-cyl. gasoline-operated engine drives an 8-mgd vertical centrifugal pump.

The Engineers Joint Council And Nuclear Problems

On August 2, 1954, the Engineers Joint Council announced initial steps toward organizing the group to meet nuclear problems.

The release to the press was as follows:

"The pressing problems of nuclear engineering and the related sciences are to be dealt with authoritatively by a group of leading engineers.

". . . Under the general policy of Engineers Joint Council to encourage the close cooperation of specialists in engineering, a strong joint agency will be set up to organize the cooperation of all engineering groups and related scientists to develop discussions of nuclear engineering subjects and to deal with the publication of worthwhile papers and addresses.

"The total membership of the federated societies known as Engineers Joint Council is about 17,000. The membership includes several thousand skilled engineers who are working on the critical problems of mining, processing and the use of all the materials involved in the production of energy by fission.

"Action by this powerful engineering group is further evidence that nuclear energy is well on the way to having important peacetime industrial usefulness."

A meeting of the Presidents of the Societies constituting Engineers Joint Council was convened on August 17, 1954, in New York City, to formulate steps in the organization of the joint program on Nuclear Science and Engineering. A general scientific and nuclear engineering conference in 1955 is contemplated.

Water Works Construction Projects and Programs

One large project nearing completing is the San Jacinto River water development program at Houston, Texas.

This has included the building of a dam across the river to form a reservoir having storage capacity of 160,000 acre-feet. The dam is slightly more than two miles long, with a maximum height of approximately 65 feet above the bed of the river. Designed by Ambursen Engineering Corp., and completed in December, 1953, the dam forms a reservoir, called Lake Houston, which will provide a dependable supply of 140 mgd.

Houston Purification Plant

Structures required for withdrawing water from Lake Houston and transporting it to the Houston Purification plant, estimated to cost $4.4 million, include an intake tower, an intake conduit, a pumping station at the lake (all of which have been completed), and a lined canal from the lake pumping station to the pumping station near the purification plant. Ground surface slope will permit gravity flow through the canal. It was expected that the canal would be completed late in 1954.

The Houston purification plant is designed to supply the maximum 24-hour requirements of a system whose average demand is 50 mgd. Initially the plant is equipped for an average demand of 33 mgd. It is capable of operation at 200 per cent of average demand. The site has sufficient space for plant expansion to 200 mgd. Operating in conjunction with the plant is a separate pumping station delivering 75 mgd of untreated water to industries along the Houston ship channel.

The purification plant was designed and its construction supervised by Freese, Nichols and Turner, Consulting Engineers, Houston, Texas. The total cost was $4.9 million, of which $385,000 was for a separate raw-water pumping plant for industrial supply.

This whole project was envisioned as early as 1943, but immediate needs had to be met with funds authorized; it was not until July, 1950, that an election was held which permitted a bond issue of $24 million to finance the development. The bonds were sold and work was started in the latter part of 1950.

Portland's Steel Pipeline

Portland, Oregon, put into service on December 18, 1953, a new conduit to take the place of the Conduit No. 1, which had been in use since 1895. The old conduit consisted of 24 miles of asphalt-coated, riveted steel pipe varying in diameter from 33 to 42 inches, with a carrying capacity of 25 mgd. The new conduit is designed to carry 100 mgd, and is made up of 10 miles of 66-inch steel pipe, having a plate thickness of 3/8 to 1/2 inch, and 15 miles of 56-inch pipe 5/16 inch thick.

Revenue Bonds at Lincoln, Nebr.

Lincoln, Nebraska, is embarking on an estimated $8.5 million water supply expansion program. These improvements are to be financed by water revenue bonds. It was necessary to submit to the electors a charter amendment to authorize the issuance of water revenue bonds. The amendment restricts the amount of bonds authorized to be issued to the estimated cost of the proposed improvement program. A $6 million issue of 30-year bonds with approximately uniform total annual principal and interest payments was marketed in November, 1953. The average interest rate slightly exceeded 2.29 per cent.

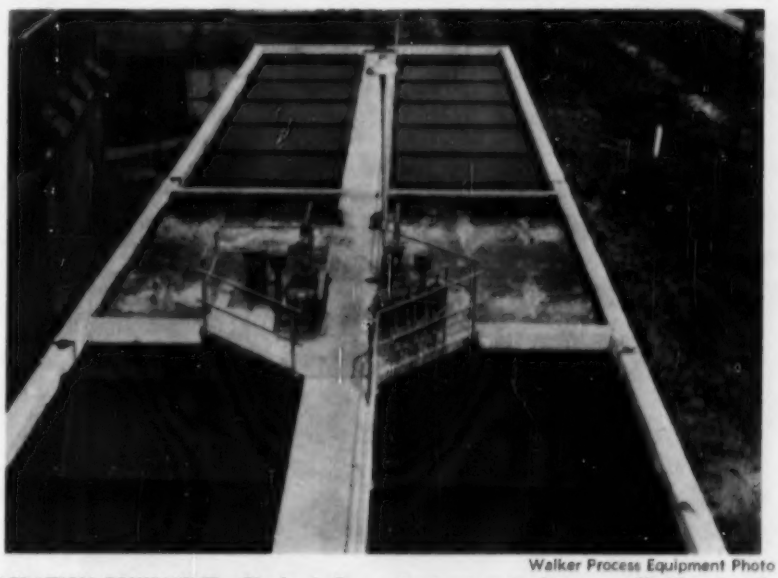
Earthquake-Resistant Covered Reservoir

At Oakland, California, a 19-mg water distribution reservoir with an earthquake-resistant, precast-concrete roof was completed in the fall of 1954. This is the second such structure to be built for the East Bay Municipal Utilities District. Additional units are planned with design modifications resulting from experience with the first two.

The columns, girders, beams and slabs are joined by welded steel plates, angles and bars cast into the members, to make the entire 149,000-square-foot roof a rigid unit. Each exterior beam and girder frames into a rubber bumper that provides yielding resistance to earthquake and temperature expansion thrust. Total contract cost of the new installation, known as Leland Reservoir, excluding real estate, was $575,000.

Dorr-Oliver Photo

HIGH-RATE TREATMENT—North Miami Beach water treatment plant capacity was expanded twice in last three years. This is second of two Hydro-Treator units.



Walker Process Equipment Photo

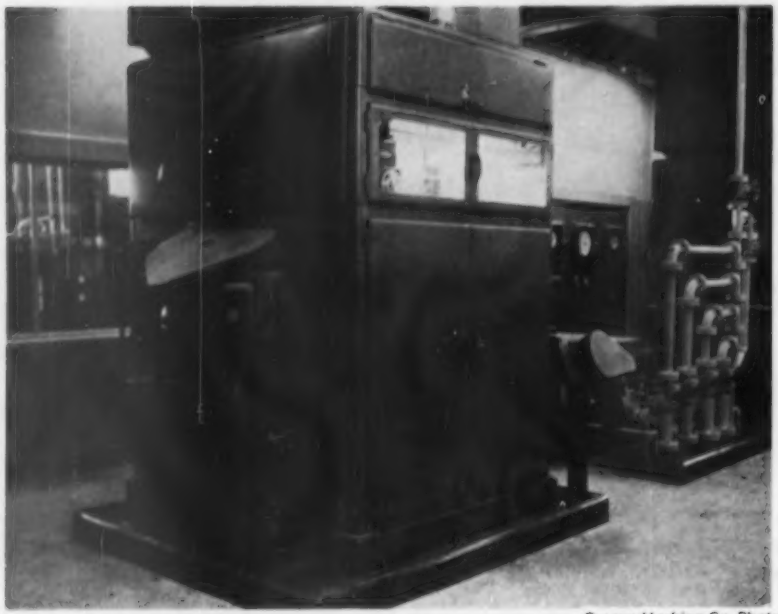
AERATION EQUIPMENT—Charleroi, Pa., water treatment plant uses Clariflow installation with Diffusair impingement aeration equipment for mixing. Flow is 4900 gpm.

Des Moines' 4-mgd Standpipe

At Des Moines, Iowa, construction of a 4-mg capacity standpipe, together with two large feeder mains running to the standpipe, was completed in the fall of 1954. This structure, in the northeast section of the city, is expected to improve pressure deficiencies in the distribution system and provide storage for high consumption periods.

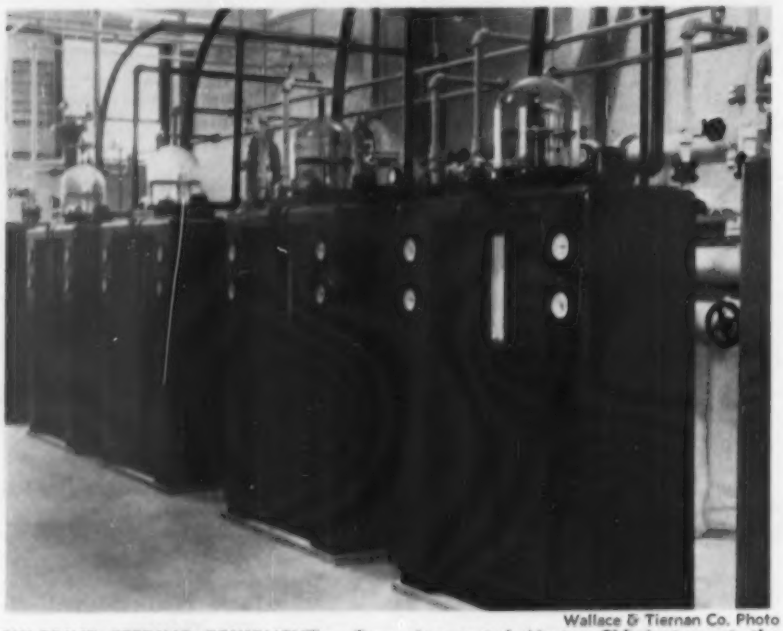
Contracts have been awarded for the building of a second standpipe of 2-mg capacity in the southeast part of the city; and plans are in the making for the erection, in the near future, of a third standpipe of 4-mg capacity in the northwest area of Des Moines. Large feeder mains will be built to all of these projects.

Consulting engineers are preparing a report outlining plant and distribution requirements necessary to meet demands in the future, up to 1980. Pumpage is increasing and it is the purpose of city management officials to attempt to keep ahead of demand. This will entail continued construction of projects in line with the recommendations of the engineering report, as well as a periodical review of anticipated needs and revision of plans as actual conditions may require.



Omega Machine Co. Photo

CHEMICAL FEEDING EQUIPMENT—This giant model is one of the new loss-in-weight chemical feeders installed in the Houston, Texas, water treatment plant.



Wallace & Tiernan Co. Photo

CHLORINE FEEDING EQUIPMENT — Four air-operated Master Chlorinators at the Haskell, N. J., plant of North Jersey Water District.

Chicago's Giant Filtration Plant

On May 24, 1954, a decision of the Illinois Supreme Court cleared the way for resuming construction of the $85 million Central District Filtration Plant in Chicago. Construction had been suspended since August 28, 1953, when the Cook County Circuit Court granted a permanent injunction against constructing this plant at the selected location in Chicago harbor. Work on the contract for the coffer dam to enclose the plant site was stopped with about thirty per cent of the work completed, for which a bid of $6.6 million had been accepted in May, 1952.

The Central District Filtration Plant will be the largest in the world, greatly exceeding the capacity of the existing 320-mgd South District plant. Total Chicago pumpage for 1953 slightly exceeded one billion gallons per day. The new plant is located near the Navy Pier.

Southern California Developments

Early in 1952 the Metropolitan Water District of Southern California started a $52 million expansion program, which is scheduled to be completed in 1955. The plan called for two new pumping units in each of the five plants and the addition of a second pump delivery line at each plant. These units were scheduled for installation in 1954.

Expansion of the distribution system includes the continued construction of feeder mains and the construction of a second barrel of the San Diego line. When fully completed the second barrel will carry Colorado River water a distance of 71 miles from the District's San Jacinto Reservoir into the San Vincente Reservoir, northeast of San Diego. The first and second barrels will be able to deliver a combined capacity of 145 mg of water per day to San Diego County.

One of the largest single projects in the program is the $3.9 million Garvey Reservoir located in Monterey Park a few miles east of Los Angeles. This reservoir will provide storage for 1,500 feet (490 mg) of Colorado River water for distribution through the District's middle feeder pipeline to the heavily populated and industrial areas in central and southern portions of Los Angeles County. Work on this reservoir is more than 75 per cent completed.

Estimates for work not yet authorized, but to be required by about 1962, total $32 million.

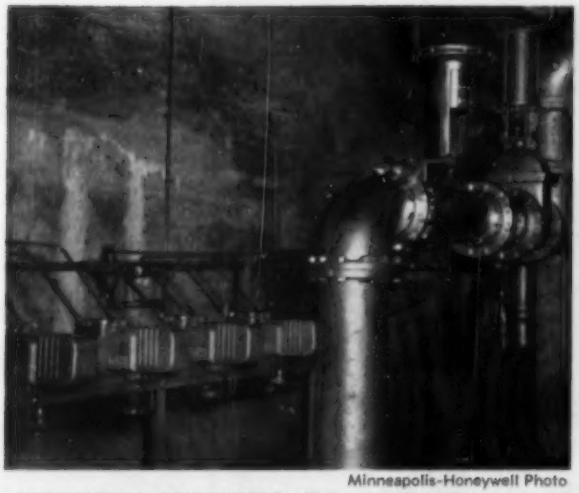
Water Works Construction

Water works projects in construction during the first 11 months of 1954 showed an increase of 4 per cent over the same period in 1953. The cost of these projects increased, over the same period, from $214 million to $223 million. Present indications are that the industry is looking forward to still greater expansion for some time into the future, as plans are being made to meet the needs of our growing population and expanding industrial development.

Highway Construction and Main Relocation

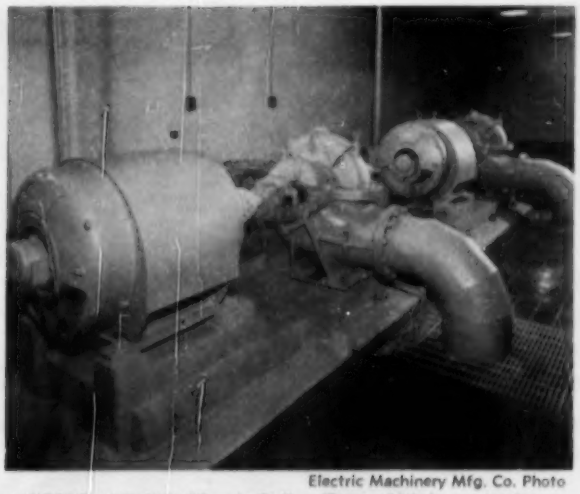
The increasing emphasis on improved road building has brought about growing problems in the relocation of water utilities, both from cost and engineering considerations.

Thomas M. Riddick, Consulting Engineer of New York, presented a paper at the New York Section,



Minneapolis-Honeywell Photo

DIFFERENTIAL CONVERTERS—Transmit filter flow rate and head loss measurements by pneumatic converters. Cunningham filtration plant, Corpus Christi, Texas.

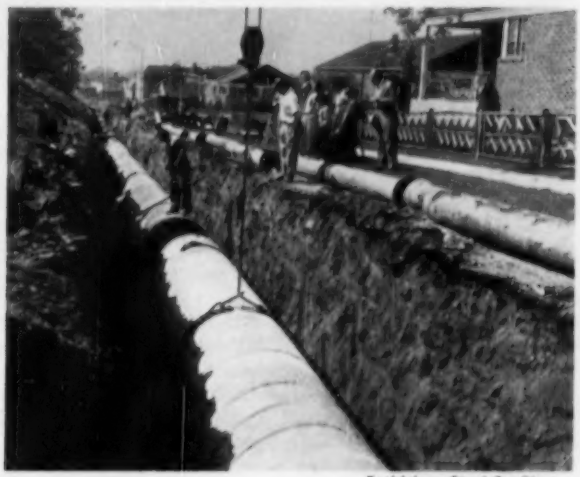


Electric Machinery Mfg. Co. Photo

MOTORS AND PUMPS—At Dallas, Texas, 250-hp squirrel cage induction motors have split sleeve bearings. Each centrifugal pump delivers 5500 gpm.

Price Brothers Photo

PRESTRESSED PIPE—This 36-in. diameter concrete steel-cylinder pressure pipe is a new 14,000-ft. water transmission line in Chicago, Ill.



Bethlehem Steel Co. Photo

TRUNK MAIN—In New York City, a new 6-mile line is ½-in. steel pipe, coal-tar enameled inside and out.

A.W.W.A., during April, 1954, in which he called attention to a number of the engineering problems encountered in connection with water works relocations required by construction of the New York State Thruway (published in the June, 1954, issue of the Association's Journal). Other discussions have appeared in the Journal from time to time in reference to costs incurred by the water utilities because of highway relocations.

At a Business and Defense Services Administration conference convened by Sinclair Weeks, Secretary, United States Department of Commerce, on June 29, 1954, representatives of the water and sewage industry and utilities suggested the adoption of a uniform, nation-wide, policy with respect to financing relocation of water and sewerage facilities made necessary by new construction of highways.

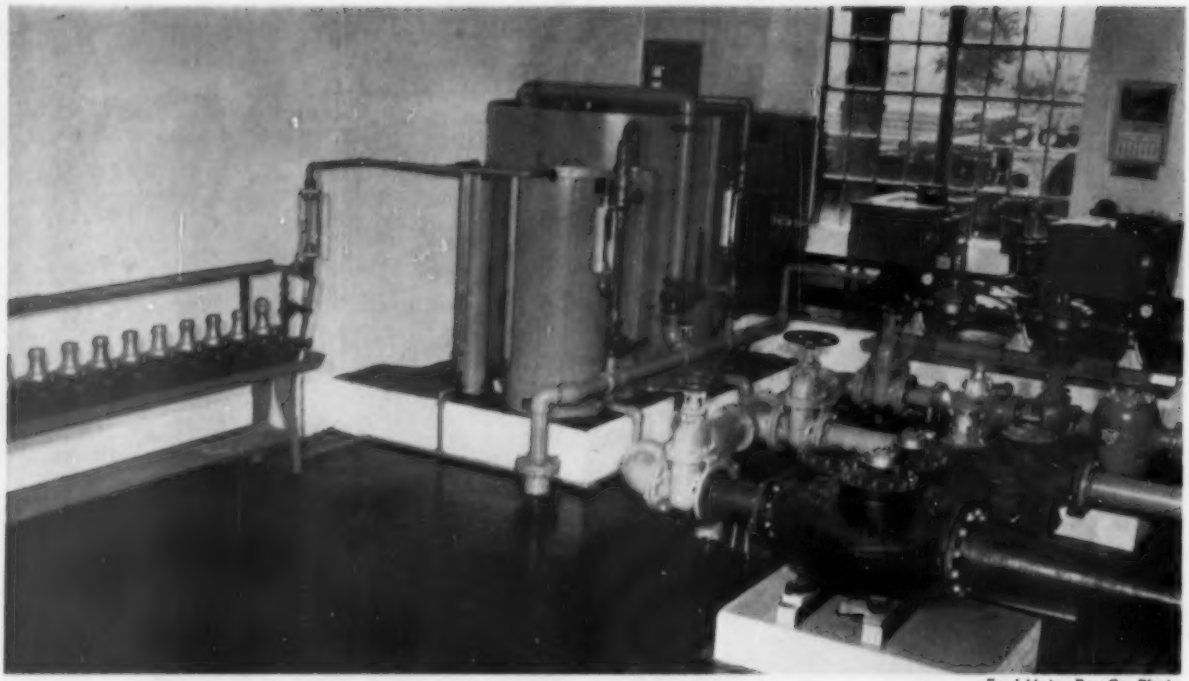
Industry spokesmen pointed out that there are only 22 states which have federal participation in financing such projects. In many cases the burden of this cost falls upon local taxpayers who receive no benefit from relocation of the water or sewerage line. It is urged by the industry that this situation be given immediate attention by appropriate Government authorities with a view to correcting any "inequities."

Congressional Hearings on Relocation

During the last session of Congress, extended hearings were held by the Public Roads Committees of both the Senate and the House. A strong representation was made for the relief of utilities from the excessive costs of relocation of installations to conform to plans of highway engineers.

At the end of April, 1954, the President signed the "Federal Aid Highway Act of 1954." Just before the bill cleared the Conference Committee the following paragraph was inserted:

"Sec. 11. The Secretary of Commerce is hereby directed to make a study in cooperation with the State Highway departments and other parties in interest relative to the problems posed by necessary relocation and reconstruction of public utilities services resulting from highway improve-



Ford Meter Box Co. Photo

METER TEST SHOP—Chester, Pa. shop has ten-unit bench for hydraulic testing of small meters (left), special tanks with double-range Testerate Indicators and piping arrangement (center) for testing of large meters (right).

ments authorized under this Act. Among other things, such a study shall include a review and financial analysis of existing relationships between the State highway departments and affected utilities of all types, and a review of the various State statutes regulating existing relationships, to the end that a full and informative report may be made to the President for transmittal to the Congress of the United States not later than February 1, 1955."

The Highway Act provides for an expenditure of approximately $1 billion annually during 1955 and 1956. At this accelerated rate of highway construction, the cost of relocating facilities is expected to increase sharply.

Utility Costs to be Determined

On August 20, 1954, at a meeting called by the Commissioner of Public Roads, representatives of the various segments of the utility industry, both public and private, were requested to cooperate with the Federal Bureau of Public Roads in obtaining data as to costs imposed on utilities during the 1953 calendar or fiscal year as a result of necessary relocations caused by certain highway projects.

A National Steering Committee, with one member representing each service, was formed at that time to arrange for assembling the required data. Mr. Harry B. Shaw, Chief Engineer, Washington Suburban Sanitary Commission, represents the water utilities. It was determined that a compilation of the data to be furnished on questionnaire forms, prepared by the Bureau of Public Roads, could best be accomplished through the creation of a committee in each of the 48 states and the District of Columbia, as well as Puerto Rico and Hawaii. At the time of this writing these committees are actively engaged in assembling this information.

Water Shortages in 1953

At the Business and Defense Services Administration conference of Water and Sewerage Industry and Utilities held at Washington, D. C., June 29, 1954, Mr. Carl G. Paulsen, Chief Hydraulic Engineer, Water Resources Division, Geological Survey, Department of Interior, also reported on a 1953 study by the Geological Survey.

From analyses of the various public water system surveys, it has been determined that over half the present water shortages are occasioned by population growth, or by increased seasonal uses, accompanied by failure to expand public water systems to keep pace with increased consumption.

What Causes Water Shortage?

In a group of 1,000 water systems which were unable to supply peak demands, and were compelled to restrict water usage, only 1 per cent of the shortage was attributable to increased industrial uses, 51 per cent was caused by population growth and increased seasonal uses, 34 per cent by supply failure, and 14 per cent by a combination of reasons.

Types of shortages were classified as those caused by inadequate water supply, or demand exceeding supply (55 per cent), inadequate treatment facilities (4 per cent), inadequate distribution facilities (20 per cent), and a combination of reasons (21 per cent).

According to a 1953 A.W.W.A. survey, shortages experienced by public supply systems serving a population of 10,000 or over were at an even higher rate, or 68 per cent, at the height of demand in midsummer; these shortages were due to inadequate water treatment and distribution facilities. Excessive demands for water in metropolitan areas during especially dry summers, as in 1953, also are aggravated by increased demands from surrounding rural areas. In some instances, water is hauled in tank trucks, delivering quantities as large as 30,000 gallons daily, at costs as high as $6.00 per 1,000 gallons.

On the whole, most of the water shortages in 1953 seem to have occurred as a result of outgrown facilities rather than from failures of water

Mueller Co. Photo

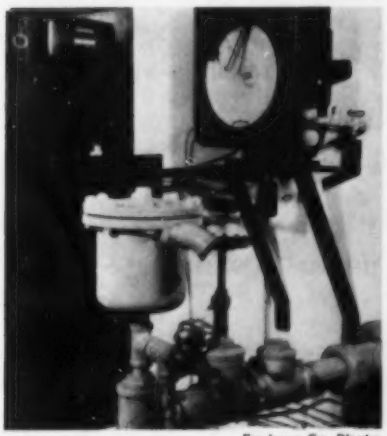
INSULATING COUPLING—Corporation stop outlet connection for plastic pipe.

Johns-Manville Photo

RING-TITE COUPLING—Transite sleeve, rubber rings and machined pipe ends.

Calgon, Inc., Photo

WELL CLEANER—Developed to remove mineral and organic deposits from wells.

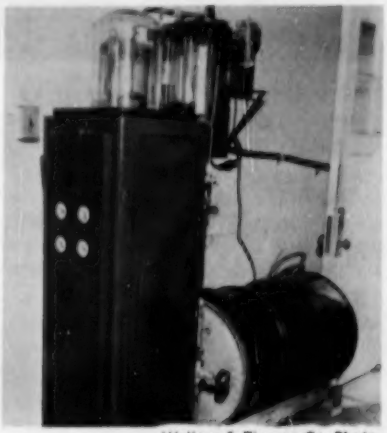


Foxboro Co. Photo

KNOXVILLE, TENN.—Pressure-Flow control operates high pressure booster pump and eliminates storage tank or reservoir.

J. B. Clow & Sons Photo

DEFIANCE, OHIO—Assembly of River-Crossing pipe, one of the first installations of this new flexible joint.



Wallace & Tiernan Co. Photo

SCOTTSBURG, IND.—Activated silica as coagulant aid increased filter runs 30 to 50% and reduced backwash time.

supplies.

1954 Drought Experience

Business Week of October 16, 1954, reports there are several unfortunate cities, in widely separated areas in the United States, whose very existence is being threatened by a complete lack of water in the area.

Lake Brandt, the main source of supply for Greensboro, N. C., went dry in early October, and an emergency pipe line was laid to draw water from nearby streams. The city's 200,000 citizens were placed under martial law. The National Guard was ordered to check water meters daily, and to cut off supplies to families that exceeded the mayor's limit of 15 gallons per person per day. A $1 million bond issue was authorized for a new dam, but that will not help the city this year.

Denver's Serious Problem

In Denver, Colorado, continuing summer droughts, light winter snowpacks, and an enormous increase both in population and in industry have resulted in a very serious problem. In 1949 there were 200,000 acre-feet of stored water (one acre-foot equals 326,000 gal.). This storage dropped to 173,000 acre-feet in 1953, and in October, 1954, was down to 96,000 —less than one year's reserve.

Recently United States Geological Survey officer, Thad McLaughlin, pointed out the seriousness of the situation in this statement: "Ground water in the Denver basin has undergone the most serious decline in the United States—in fact, if it continues long there is a distinct possibility that the whole city will begin to settle." He explained this would be a slow process, and there was no immediate danger. The city sits on an upturned cone basin. When the water recedes below it the earth in the cone dries up and slowly sinks. The two sandstone strata that carry the water underground from the mountains are so tight that they replenish slowly, if at all. Recently an artesian well south of Denver had to go down 2,100 feet to tap a sufficient flow.

Water authorities of Denver are considering three solutions: (1) Buy up irrigated land, turn it back into prairie and divert the irrigation water into the city system. (2) Tunnel water from the western slope rivers; this attempt at diversion of Colorado waters would run into legal difficulties with California and other western states. (3) Bring mountain stream water at a modest rate of 177,000 acre-feet per year into Denver, strictly for domestic use.

A suit pending is that of Arizona vs. California over Colorado River water rights; the State of California petitioned the United States Supreme Court on July 15, 1954, to make the upper basin states of Colorado, New Mexico, Utah and Wyoming parties to the suit. The Court was to take action on this after it reconvened late in 1954.

George I. Haight, a Chicago attorney, was appointed Special Master

National Water Main Cleaning Co. Photo

PIPE TUBERCULATION—Section of 8-in. main laid in Columbus, Ga., in 1917 and cleaned in 1954. Cleaning required pulling machine through two 1000-ft. sections, then forcing it through again by water pressure.

by the Supreme Court last June to take evidence in the case. Chief Justice Earl Warren has disqualified himself from participating in the controversy.

Mahoning River Problems

In Ohio, towns along the Mahoning River have grown so fast that they have absorbed all the stream water for miles around. A proposed project to pipe Lake Erie water inland to the headwaters of rivers during dry months seemed like a solution for Mahoning cities, but a treaty with Canada prohibits it. A United States-Canadian agreement specifies that water pumped from Lake Erie must be returned to it. The Mahoning River water flows, finally, into the Gulf of Mexico.

Other communities in the country are in a similar situation. Phoenix, Arizona, and Midwest City (a suburb of Oklahoma City) have issued building bans because they are afraid new residents will be without water.

Officials of cities along the Delaware River and in parts of Florida, South Carolina, and Georgia are concerned because dropping water tables bring the flow of salt water inland, spoiling the fresh supply.

Water From the Sea

Research being conducted by the U. S. Department of Interior on the desalting of sea water was reported in *Business Week* of May 8, 1954. These studies, authorized under a five-year program approved by Congress in 1952, have objectives which are different from similar military projects. Defense work is not aimed primarily at producing water at lowest costs. For the military, portability of equipment and ease of operation and maintenance are more important than cost. Costs must be competitive before non-military users are interested.

All six processes that appear to be the most promising are in various experimental and demonstration stages:

1. Vapor compression distallation was used in some sizable locations during the war. Recently the Badger Manufacturing Co., Cambridge, Mass.., has developed a radically new type of compression distallation equipment which involves creating a turbulence in water at the boiling point, thus producing steam without as much energy as is normally required.

2. Interior has signed a contract with Ionics, Inc., also of Cambridge, to field-test Ionics' electric membrane process, which uses an electric current to move the minerals through plastic membranes. Rohm & Haas, a Philadelphia chemical firm, while not under contract, is sharing research results with Interior on similar work.

3. Bjorksten Research Laboratories of Madison, Wisconsin, is investigating the use of plastic apparatus for solar evaporation.

4. Temperatures near 700° F. and pressures of 3,200 lb. per sq. in. would be used for desalting in a method proposed by Nuclear Development Associates of White Plains, N. Y.

5. The University of California at Berkeley is investigating the economics of the thermal difference method. (The French are reported to be building such a plant at Abidjan on the coast of French West Africa.)

6. Multiple effect evaporation, a continuous process for evaporating fresh water from salt water, is used in such locations as Kuwait, in the Middle East. Costs of this process seem too high for use in the United States.

Various Water Problems

In a paper presented at the A.W.W.A. Conference in Seattle, May, 1954, Irving P. Krick, President of the Water Resources Development Corp., Denver, Colorado, reported that his organization, during the past five years, has completed approximately 250,000 hours of broad-scale cloud-seeding operations in eighteen states and six foreign countries. An assessment of results is contained in approximately 195 reports covering these operations, in the files of the American Institute of Aerological Research.

Weather Control

During its initial phases, cloud seeding was considered by a large segment of the legal profession to be a hazardous operation. To avoid unsound practices in the development of cloud seeding, both state and federal legislation has been enacted to a limited extent. State regulation has taken the form of licensing arrangements, insurance requirements, and enabling legislation to permit assessments to cover cost.

The federal government in December, 1953, set up an advisory committee on weather control which will report to the President in 1956. The primary purposes of the committee are to evaluate cloud-seeding operations from a technical and economic standpoint, to recommend any regulatory legislation which may seem desirable, and generally to monitor the whole evolution of weather control both from a military and a civilian point of view.

A task group under the A.W.W.A. Water Resources Division is working on a survey of legislative proposals and action in the various states in reference to weather control.

Missouri River Program

The United States Senate on August 18, 1954, approved legislation (Senate Bill 2821) authorizing the 10 states of the Missouri River basin to enter into a compact for development of the basin area. The states

involved are Colorado, Wyoming, Montana, North Dakota, South Dakota, Nebraska, Kansas, Missouri, Iowa, and Minnesota. This bill was sponsored by the Missouri River States Committee, of which Governor Sigurd Anderson of South Dakota is chairman.

After the states, in cooperation with the federal government, agree on a compact, it must be approved by Congress before becoming effective. [Ed. note: The enabling bill did not pass the House, but presumably will be presented in the next Congress.]

Water Fluoridation

The September, 1954, issue of the A.W.W.A. Journal carried the extensive report of the Committee on Fluoridation Materials and Methods which was presented at the Annual Conference of the Association.

As of December 31, 1953, there were more than 840 communities in the United States using fluoridated water. On August 12, 1954, Osawatamie, Kansas, became the 1000th city to fluoridate its water.

Safety Practices

Four task groups of the A.W.W.A. Committee on Safety Practices, under the direction of Raymond J. Faust, have been active in the preparation of a safety manual for water utilities. The subject matter will cover practically all activities, and is being developed to make recommendations applicable to small, as well as large, water utilities. The first draft of the text was distributed to committee personnel the first of August, 1954, and it is expected that the manual will be ready for distribution early in 1955.

Social Security Coverage

The federal social security law as it applies to Old-Age and Survivors Insurance was amended by the 1954 Congress.

One change was made which permits persons employed by a State or local government (with the exception of policemen and firemen) to secure social security insurance protection under special agreements between the State government and the Federal Government *even if they are already under a local retirement system,* provided a majority of the members of the system vote in favor of social security coverage.

Employees whose jobs are under a retirement system, but who themselves are not eligible for membership, under the 1954 amendment can be covered by social security without a referendum. Amendments to the social security law in 1950 permitted a similar method of coverage—but only if the employee group was *not* covered by a local plan at the time the State made the special agreement with the Federal government.

The 1954 amendment makes it possible for employees of all municipally owned, or other publicly owned, water works to secure social security coverage, regardless of whether or not they are covered by a previously established local plan.

Other changes brought about by the 1954 amendments include:

1. Increased payments starting October 1, 1954, to persons already retired and receiving monthly benefits;

2. Increased payments for future beneficiaries, as a result of a. counting workers' earnings up to $4,200 each year commencing in 1955 (heretofore earnings up to $3,600 were taxed); b. dropping out some of the years of lower earnings (or no earnings) in figuring average earnings; and c. using a new formula for figuring the worker's benefit from his average earnings.

Also, beginning in 1955, a person 72 years of age or over may draw full social security benefits regardless of the amount of other earnings. For persons under 72, earnings up to $1200 per year are permitted while drawing full social security benefits; with certain reductions in benefits where earnings exceed $1200 in a year.

The new law also makes provision for "freezing" the earnings record of individuals totally disabled, thereby protecting insurance rights while disabled, but *not providing cash disability payments.*

Public Relations

The American Water Works Association has always emphasized the importance of good public relations in the field of management, and in recent years special emphasis has been put on this phase of water works operation.

The A.W.W.A. continues to work effectively in this field, especially through its several publications: the Journal, which carries important technical material; Willing Water, using a more informal presentation of information; and various reprints of pertinent material. During 1954 a picture booklet was prepared for distribution; it presents the story of water supply in the style of the comic book, and has a special appeal for school children.

The Public Relations Committee of the Association has been at work on the project of having the United States Post Office Department issue a stamp commemorating the 75th anniversary of the Association.

Harry E. Jordan Award

At the last national conference of the Association in Seattle in May, 1954, the Water and Sewage Works Manufacturers Association voted to establish an annual grant of $1,500 for scholarship aid to students in engineering courses which, when applied in active life, would lead to the improvement of public water supply service. This scholarship is to be known as the "Harry E. Jordan Educational Award."

Plans are being made for a meeting of the International Water Supply Association to be held in London in 1955. The International meeting is one in which a series of special reports are prepared and presented by "general reporters" whose material is submitted to them by "national reporters" in the cooperating countries.

Needs of the Future

Looking back over the accomplishments of the water works industry during the year 1954 it is apparent that much progress has been made. A great deal remains to be done to meet both the immediate and the future requirements for water service. We have no doubt that our industry will continue to put forth a determined and successful effort to meet the challenging needs which lie ahead.

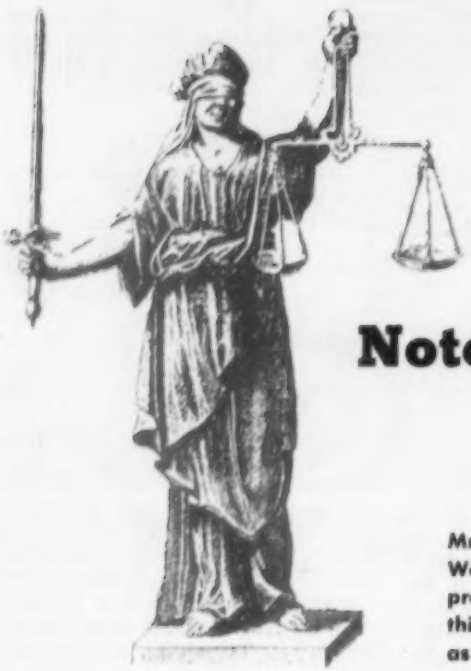
W&SW

Opinions on Fluoridation Still Divided

In Miami, Fla., Dr. L. M. Fitzgerald, president of the Am. Dental Ass'n, told this group in convention that water fluoridation is now in operation in 1,020 cities with a combined population of more than 20 million. Dr. Fitzgerald referred to water fluoridation as a major step in the attempt to improve the nation's dental health through the control of caries.

At the same time the people of a number of important cities voted against fluoridation of the local water supply. Amongst these cities were Salem, Oregon; Meadville, Pa.; Greensboro, N. C.; Birmingham, Ala.; Fremont, Neb.; Peekskill, N. Y.; Atlantic City, N. J.

Palo Alto, Calif., and Mountain Home, Ark., voted in favor of the treatment.



Bettman Archive

Notes on Water Works Law

by JOHN H. MURDOCH, JR.

Mr. Murdoch is Vice-President and Counsel, Amer. Water Works Service Co., Philadelphia, Pa. He has prepared exclusively for *Water & Sewage Works* this series of articles discussing water works law as it applies to source of supply, water quality, and water distribution.

Second Installment—Irrigation and Riparian Rights

THIS section of the notes has to do with the law on use of the waters of streams for irrigation as related to riparian rights. In more than a majority of our states the common law regarding riparian rights as briefly stated above is applied strictly to questions concerning the right to use stream water for irrigation. In some of the western states the common law rules have been either modified or entirely set aside because of historical developments or local conditions. Some discussion of these western laws will be given but the subject is so complex and is so much a distinct branch of the law involving state constitutional and statutory law that it should be covered only by an expert in that branch. The present writer is not such an expert.

While there are a few old cases in the various eastern state reports dealing with the relative rights of upper and lower riparian owners as affected by irrigation, the actual practice of irrigation of riparian lands has not been common enough to lead to any great number of litigations. Perhaps, also, the cases are relatively rare because of the wide knowledge and acceptance of the basic riparian rights law. In England, from which country we brought our common law concepts, irrigation was uncommon because of the humid climate and in our eastern and central states the normal rainfall during the growing season was high enough to make irrigation for most crops uneconomic.

In the very recent past, water works officials have become aware of a developing trend toward irrigation because in many instances the practice has seriously depleted the volume of water reaching water supply intakes in streams depended upon for public water supply. Mr. Howard T. Critchlow, Director of Division of Water Policy and Supply of the New Jersey Department of Conservation and Economic Development has devoted considerable study to the extent of irrigation in his state and in all of the humid states. Mr. Critchlow presented a paper on September 9, 1954, before the Irrigation and Drainage Division, ASCE on "Water Rights in Humid Areas." In that paper Mr. Critchlow set forth some very arresting figures based on information or estimates given to him by officials of state agencies. For instance, in 1954 in the 31 humid states 2,417,924 acres are estimated to have been irrigated and in the 14 northeastern states 228,950 acres were irrigated, an increase of about 77% over the figure for 1950. These statistics are mentioned to show why water works officials should be interested. It is obvious that in years when rainfall is deficient there will be more division of stream flow for irrigation, at the very time stream flow is low because of deficient rainfall and when public water supply demands tend to increase. There appears to be a serious conflict of interest in prospect, and informed, constructive thinking is essential.

To show the application of the common law of riparian rights to irrigation use, five typical cases are given. These cases are from Connecticut, Illinois, Pennsylvania, New Jersey and Michigan. Their dates in the order above are 1793, 1839, 1848, 1879 and 1896.

Perkins v. Dow, 1 Root's Reports, 535 (Conn.) March Term 1793—Windham County:

Facts: Dow owned riparian land a part of which was a valuable meadow. Perkins owned riparian land downstream and used water from the stream for his water-powered grist-mill, his cattle, and for "flowing" his land. Dow, upstream, diverted water to irrigate his

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As has been shown, the owner of lands bordering on a stream has a property right to have the water of the stream flow down to his riparian lands as it was accustomed to flow, undiminished in quantity and unimpaired in quality. He also has a property right to make a reasonable use of the water of the stream on his riparian lands, although he does not own the water. His ownership is in the right to reasonable use of the water—the usufruct—not ownership of the water itself. These property rights are known as riparian rights.

Each owner of riparian lands also has what might be called riparian duties. Each has the duty of allowing the flowing water of the stream to flow down to those below undiminished in quantity and unimpaired in quality, except as it may be diminished in quantity or impaired in quality by reasonable use on riparian lands.

He also has the duty to let the water of the stream flow in its accustomed channel where it leaves his land and to flow into the land immediately below. He has the duty of allowing the water to leave the land of the proprietor upstream unimpaired in its channel so that the water is not backed up on the upstream lands. Thus each riparian owner has both rights and duties.

meadow and by that diversion damaged Perkins.

Decision: Perkins was allowed damages. The court said, in part:

"The defendant had right to use so much of said water, passing through his land, as to answer all necessary purposes, to supply his kitchen, and for watering his cattle, etc., also he had right to use it for beneficial purposes, such as watering and enriching his land; but this right hath restrictions, and must be so exercised as not to injure the plaintiff, who lies next below, and who hath right to have the surplus flow into his land in the natural channel; and which appeared might easily have been done in this case; the defendant, therefore in diverting the surplus of the water, not used by him, out of its natural course and away from the plaintiff's land was an injury and a nuisance. Upon which the jury found a verdict for the plaintiff, and £15 damages. * * *"

In this Connecticut case it may be noted that the court held that the upstream owner had the right to use the water "to enrich his lands" but that the right had "restrictions" and "must be so exercised as not to injure the plaintiff, who lies next below * * * ." The court then wrote about the duty to allow the surplus to flow into the natural channel and the failure of the defendant to so do. It is the opinion of the writer that if the natural flow was great enough to supply the needs of both, then the failure to return the unused surplus was the basis for the award. On the other hand, if there was not enough for both, then a taking of water for irrigation to an extent which would injure the downstream owner by depriving him of at least equal amounts of water for irrigation would be an invasion of the rights of the lower riparian owner.

The 1839 Illinois case of *Evans v. Merriweather*, 4 Ill. 492, was not an irrigation case but one involving the use of water for boiler feed in mills. However, the court discusses the general principles clearly and points out a distinction often made between use for irrigation and use for domestic purposes and for watering stock. To the Illinois court in this case irrigation "rights" should be subordinate to rights to satisfy natural wants. The point is important and for that reason the case is cited.

Evans v. Merriweather, 4 Ill. 492. Decided about 1839.

Facts: Evans and Merriweather each operated a steam power mill on a small stream which in most years had enough flow to supply both mills with water for boiler use. In the dry year of 1837 there was not enough water for both mills and Evans, upstream, used so much that Merriweather could not operate his mill.

Decision: Merriweather was given damages on the basis that Evans use was unreasonable.

The Supreme Court in affirming the judgment discussed the applicable law very clearly. Some of the statements follow: (Emphasis supplied.)

"Each riparian proprietor is bound to make such a use of running water, as to do as little injury to those below him, as is consistent with a valuable benefit to himself. The use must be a reasonable one. Now the question fairly arises, is that a reasonable use of running water by the upper proprietor, by which the fluid itself is entirely consumed? To answer this question satisfactorily, it is proper to consider the wants of man in regard to the element of water. These wants are either natural or artificial. Natural are such as are absolutely necessary to be supplied, in order to his existence. Artificial, such only as by supplying them, his comfort and prosperity are increased. To quench thirst, and for household purposes, water is absolutely indispensable. In civilized life, water for cattle is also necessary. These wants must be supplied, or both man and beast will perish.

"The supply of man's artificial wants is not essential to his existence; it is not indispensable; *he could live if water was not employed in irrigating lands,* or in propelling his machinery. In countries differently situated from ours, with a hot and arid climate, water doubtless is absolutely indispensable to the cultivation of the soil, and in them, water for irrigation would be a natural want. *Here it might increase the products of the soil, but it is by no means essential, and cannot therefore be considered a natural want of man.* So of manufacturers, they promote the prosperity and comfort of mankind, but cannot be considered absolutely necessary to his existence; nor need the machinery which he employs be set in motion by steam.

"From these premises would result this conclusion; that an individual owning a spring on his land, from which water flows in a current through his neighbor's land, would have the right to use the whole of it, if necessary to satisfy his natural wants. He may consume all the water for his domestic purposes, including water for his stock. If he desires to use it for irrigation or manufactures, and there be a lower proprietor to whom its use is essential to supply his natural wants, or for his stock, he must use the water so as to leave enough for such lower proprietor. Where the stream is small, and does not supply water more than sufficient to answer the natural wants of the different proprietors living on it, none of the proprietors can use the water for either irrigation or manufactures. * * *"

In the case of Miller v. Miller, decided by the Supreme Court of Pennsylvania in 1848, irrigation was directly involved. The court reached the conclusion that an upper riparian owner has no right to materially reduce the flow of the stream through diversion for irrigation. This standard has been questioned in some western decisions but it may still be sound law in the east at least. Also in this case both the trial court and the Supreme Court have some instructive things to say about irrigation rights as related to the size of the stream. Their thoughts in this regard are surely sound.

Miller v. Miller, 9 Pa. 74, Sunbury July Term 1848.

Facts: An upstream riparian owner diverted water from a stream for irrigating his land. A lower riparian owner brought suit for damages. Judgment was in favor of the plaintiff and on appeal to the Supreme Court of Pennsylvania the judgment was affirmed.

Decision: The judge in the lower court, Wilson, P. J., charged the jury as follows: "A man may use the water for the purpose of watering his meadows, provided he so constructs his races, or the ground is so situated, that any surplus will return again into the natural channel before it reaches the occupant below him, and provided the flow of water which the occupant below was previously entitled to the use of, is not materially diminished; where he goes beyond this, even for watering his meadows, he must retain the right to do so from the occupants on the stream below, or he subjects himself to a suit for damages, although the damages be small; whether a stream is materially diminished, so as to subject the occupier who diminished it to damages, must in some measure depend on the capacity of the stream; when the stream is so large as to come under the denomination of a creek or river, a large quantity may be used for irrigating land, without any appreciable diminution of the quantity, and no one injured, or have a cause of action against the person lessening the quantity. But when the stream is so small that the quantity taken for irrigation perceptibly and materially diminishes it, the person affected by it will have cause of action, *and the question does not turn on whether the occupier below who complains, has sufficient water left for his domestic purposes, or more than he was previously using from the stream, but whether the quantity flowing on to his land, which he had a right to use, has been materially lessened or diminished.*"

The opinion of the Supreme Court reads, in part, as follows: "Bell, J.—As the evidence given on the trial is not brought up with the record, we are unable to ascertain the precise extent of the diversion of the water in question, or of its use by the defendant. Nor is this, perhaps, necessary to enable us to decide understandingly the principal point presented on the argument. It is not whether the owner above has a right to use the water flowing through his lands for the purposes of irrigation, but whether he is bound so to use it as not materially to diminish the quantity which before flowed over and across the land of the occupier below.

"The general rule on this subject is, that any proprietor of lands on the banks of a river or other stream, has an equal right to use the water which flows adjacent to his property; but, without the assent of the adjoining proprietors, he cannot divert it or diminish the quantity of water which would otherwise descend to the proprietors below. The law requires of the party that he should use the stream in a reasonable manner; and one of the conditions of this use is, that he do not destroy or render useless, or materially lessen or affect the application of the water by those situated above or below him on the stream. The general doctrine will be found thus stated by most of the best writers on this subject, in whose treatises are collected the numerous cases which might be cited in support of it.

* * * To the same effect is *Arnold v. Foot,* 12 Wend. 330. There it was held that the owner of land upon which a spring rises has no right to divert it from its natural channel, although its waters are not more than sufficient for his domestic uses, for his cattle, and for the irrigation of his land. The sum of the authorities may be thus briefly stated: Though every proprietor has a right to the reasonable use of the water running through his lands, he cannot, by the mere act of opposition, diminish the quantity of water which ran through his neighbor's land, to the prejudice of his estate in point of value, although enough was still left to the neighbor for the purposes for which he had actually used the water. Though this is the settled doctrine, some difficulty frequently occurs in its application to particular cases, arising principally from the peculiar uses to which water may be applied, and the consequent necessity of managing it in a particular way. * * * The distinction taken by the court below between a stream so large as to be properly designated a creek or river and a mere rivulet used for the purposes of irrigation, is perfectly well founded. In the one case, of course a much larger quantity may be absorbed without perceptible diminution or actual injury, than in the other. In the use of it, some evaporation and decrease of it, and some variation in its weight and velocity, must necessarily take place. In such case the maxim is, *de minimus non curat lex.* But whenever so much of the volume of water is obstructed as to be plainly perceptible in its practical uses below—whenever the channels which before were filled, exhibit the loss of the accustomed fluid, an injury is committed for which an action may be sustained, though it may not have been actually used by the lower proprietor. It is scarcely worth while to elaborate the subject which, in the aspect it assumes in the case in hand, is sufficiently simple. It may not, however, be useless to illustrate it by the remark, to which all must assent, that the owner above cannot take all of the stream, and this drives us necessarily upon the rule that he shall not materially diminish it, for, from the very nature of the subject, there is none other of practical operation.

"For this reason, we find no error in that part of the charge principally complained of. The learned judge was right in saying that 'the question does not turn on whether the occupier below, who complains, has sufficient water left for his domestic purposes, or more than he was previously using from the stream; but whether the quantity flowing on his land, which he had a right to use, has been materially lessened or diminished?' * * * "

The New Jersey case of *Farrell v. Richards,* 1879, 30 N. J. Eq. Term, Eq. 511 is again one in which irrigation was directly involved. The defendant admitted the diversion and defended on the specific ground of his right to divert for irrigation. The court denied this alleged right and in so doing took essentially the same attitude toward "material reduction" as was taken in the Miller case, supra, in Pennsylvania. The language differs slightly but the thought is the same.

Facts: Farrell owned a water power mill on Forge Stream. Richards owned a large tract of land upstream from the mill and diverted water out of Forge Stream to

irrigate cranberry bogs. The diversion was so great as to seriously interfere with the operation of the Farrell Mill. Farrell sought an injunction. Richards claimed that as a riparian owner he had the right to the water which was taken for irrigation.

Decision: Injunction granted. The court used this language: (Page 515) "The defendant has no right to so use the water as to diminish its quantity to the prejudice of the complainants. While every riparian owner has a right to use the water flowing through his land for the proper irrigation of his land, his use for that purpose must be such as not essentially to interfere with the natural flow of the stream, or essentially and to the material injury of the proprietors below to diminish the quantity of water that goes to them."

In *Mastenbrook v. Alger,* 1896, Michigan, 68 N.W. 213 decided July 28, 1896, there was a conflict of interest between two riparian owners. As there was not enough for both "natural wants" and irrigation, irrigation was enjoined. The court here made the same distinction between domestic and natural wants and irrigation as was made by the Illinois court in Evans v. Merriweather, supra.

Facts: Action for injunction to restrain defendant from taking water from a stream for irrigating his upstream riparian lands and thereby depriving the plaintiff of water for his riparian lands downstream for domestic use and for his stock. The volume of water furnished by the stream was barely sufficient to sustain the stock of the defendant, the plaintiff and other riparian owners for their natural wants and for domestic use. There was not sufficient volume of water so that the defendant could use any part for irrigation.

Decision: Injunction granted. Affirmed on appeal. The defendant was "allowed to have the use of so much water in the stream as shall be necessary for ordinary purposes in supplying his natural wants, including the use of the water for domestic purposes and for stock in connection with his home and farm, *and for no other purpose;* * * *" (Emphasis added.)

In the section of the United States which Critchlow refers to as humid, the law concerning the right of a riparian owner to divert water for irrigation clearly follows the common law of riparian rights. Water may not be diverted for the irrigation of any land not strictly riparian. Use on other lands could not conceivably be supported as a riparian right. Next, and again negatively, water may not be diverted for irrigation if thereby lower riparian owners are deprived of water for domestic purposes and stock watering. Again a negative, water may not be diverted for irrigation if thereby lower riparian owners are deprived of the opportunity to irrigate their riparian lands to the same extent as the upper owner. Certainly, as was pointed out in Miller v. Miller, large quantities can be taken from large streams without running foul of these negatives. As to smaller streams it might be too much or that the flow may not be "materially reduced." Once again it appears to be necessary to judge each case on its own facts and reach a conclusion on whether the taking for diversion is "reasonable" once the taking is understood not to violate any one or more of the clear negatives. There is no easy answer that has so far been discovered.

Improved pumps, light weight pipe and increased values of crops together with current low rainfall create a situation of urgency as to irrigation and public water supply. To the extent that irrigation as practiced in any particular case is a property right as a legal exercise of a riparian right, it can only be stopped by legal process by acquisition of the upstream owner's right. Eminent domain may be necessary and available if the right is required for public water supply. If the irrigation diversion be illegal because unreasonable as a riparian right, injunction is the remedy.

Fragments of Notes on Western Irrigation

One of the bright dreams of the writer has been that sometime there would be the time for a study of the water laws west of the 100th meridian. Without such study they are even more confusing than the admitted confusion of the common law as interpreted by the courts and modified by legislation. However, even a rather hurried glance at early western cases has turned up some interesting background history which water works men should consider. The "hurried glance" led to a reading of the longest case report in the writer's recollection. *Lux v. Haggin,* 69 Cal. 255—over two hundred pages. The case is cited repeatedly in later cases and no wonder. It discusses history, legislation and practically every pertinent case in England and America.

The cases abstracted below are offered as a sampling and as an introduction to further study. The writer makes no representation that they state the law as of today but they constitute valuable background and as such are offered.

Jennison v. Kirk, 98 U. S. 453; Error to Supreme Court of California. Judgment of lower court affirmed.

This case is important for our purposes only because of the statement of the history of the water diversion laws in California and in the other western states as set forth in the opinion of the court on pages 457 and 458, as follows: "* * * The discovery of gold in California was followed, as is well known, by an immense immigration into the State; which increased its population within three or four years from a few thousand to several hundred thousand. The lands in which the previous metals were found belonged to the United States and were unsurveyed, and not open, by law, to occupation and settlement. Little was known of them further than that they were situated in the Sierra Nevada mountains. Into these mountains the emigrants in vast numbers penetrated, occupying the ravines, gulches, and cañons, and probing the earth in all directions for the precious metals. Wherever they went, they carried with them that love of order and system and of fair dealing which are the prominent characteristics of our people. In every district which they occupied they framed certain rules for their government, by which the extent of ground they could severally hold for mining was designated, their possessory right to such ground secured and enforced, and contests between them either avoided or determined. These rules bore a marked similarity, varying in the several districts only according to the extent and character of the mines; distinct provisions being made for different kinds of mining, such as placer mining, quartz mining, and mining in drifts or tunnels. They all recognized discovery, followed by appropriation, as the foundation of the possessor's title, and development by working as the condition of its retention. And they were so framed as to secure to all comers, within practicable limits, absolute equality of right and privilege in working the mines. Nothing but such equal-

ity would have been tolerated by the miners, who were emphatically the lawmakers, as respects mining, upon the public lands in the State. The first appropriator was everywhere held to have, within certain well-defined limits, a better right than others to the claims taken up; and in all controversies, except as against the government, he was regarded as the original owner, from whom title was to be traced. But the mines could not be worked without water. Without water the gold would remain forever buried in the earth or rock. To carry water to mining localities, when they were not on the banks of a stream or lake, became, therefore, an important and necessary business in carrying on mining. Here, also, the first appropriator of water to be conveyed to such localities for mining or other beneficial purposes, was recognized as having, to the extent of actual use, the better right. The doctrines of the common law respecting the rights of riparian owners were not considered as applicable, or only in a very limited degree, to the condition of miners in the mountains. The waters of rivers and lakes were consequently carried great distances in ditches and flumes, constructed with vast labor and enormous expenditures of money, along the sides of mountains and through cañons and ravines, to supply communities engaged in mining, as well as for agriculturists and ordinary consumption. Numerous regulations were adopted, or assumed to exist, from their obvious justness, for the security of these ditches and flumes, and the protection of rights to water, not only between different appropriators, but between them and the holders of mining claims. These regulations and customs were appealed to in controversies in the State courts, and received their sanction; and properties to the value of many millions rested upon them. For eighteen years—from 1848 to 1866—the regulations and customs of miners, as enforced and moulded by the courts and sanctioned by the legislation of the State, constituted the law governing property in mines and in water on the public mineral lands. * * *"

As was developed in *Jennison v. Kirk* case, supra, much of the water law in the west is based on prior appropriation. We have seen that some property belonged to the one who first appropriated it by reducing it to beneficial use. Later some formal proceedings were developed to evidence the appropriation but the essential ingredient was a taking for beneficial use prior to the vesting of a better title. Complications were presented when the timing or the fact of acquisition of the paramount title of the United States came into the situation. In the following case the right to appropriate water for irrigation is discussed. In the Jennison v. Kirk case, mining was considered. Note also in the next case that even appropriation must be reasonable.

Basey v. Gallagher, 87 U. S. 670. Appeal from Supreme Court of the territory of Montana. Mr. Justice Field made this statement: "The question on the merits in this case is whether a right to running waters on the public lands of the United States for purposes of irrigation can be acquired by prior appropriation, as against parties not having the title of the government. Neither party has any title from the United States; no question as to the rights of riparian owners can therefore arise. It will be time enough to consider those rights when either of the parties has obtained the patent of the government. At present both parties stand upon the same footing; neither can allege that the other is a trespasser against the government without at the same time invalidating his own claim."

From page 683: "* * * It has been held generally through the Pacific States and territories that the right to water by prior appropriation for any beneficial purpose is entitled to protection. Water is diverted to propel machinery in flour-mills and saw-mills, and to irrigate land for cultivation, as well as to enable miners to work their mining claims; and in all such cases the right of the first appropriator, exercised within reasonable limits, is respected and enforced. We say within reasonable limits, for this right to water, like the right by prior occupancy to mining ground or agricultural land, is not unrestricted. It must be exercised with reference to the general condition of the country and the necessities of the people, and not so as to deprive a whole neighborhood or community of its use and vest an absolute monopoly in a single individual. * * *"

Mention was made above of the case of *Lux v. Haggin* with its long report. The case seems to be authority for the statement that a riparian owner who acquired his lands prior to an appropriation of the water by an appropriator had common law rights in the stream which could not be divested without compensation.

The next case, from Nevada, sets forth the full impact of the law of appropriation.

Jones v. Adams, 19 Nevada 78, April Term 1885.

Facts: Jones was the owner of riparian lands on Sierra Creek and Adams was the owner of upstream riparian lands. Both used water from the creek for irrigation. Jones claimed that Adams had no right to deprive him of any water through its use for irrigation, basing his claim on the common law regarding riparian rights. Adams defended on the basis of the law of "appropriation." The lower court found that Jones "first appropriated and used and * * * is the owner by rights of appropriation and use of seven-tenths of all the water customarily flowing in said stream; * * * is entitled to use, as the first appropriation upon his land and upon each and every part thereof, seven-tenths of all the water customarily flowing in Sierra Creek; and is entitled to divert the same upon his land * * * for the irrigation thereof; and to use so much of the said seven-tenths of said stream as is necessary for his stock and domestic purposes." The lower court made a similar finding to the effect that Adams was the appropriator of three-tenths of the flow. Jones appealed because his claimed rights under the common law regarding riparian lands had not been vindicated.

Decision: The Supreme Court of Nevada sustained the lower court. It held that even the common law would not have deprived the upper riparian owner of the right to a reasonable use of the water of the stream for irrigation. Later the court proceeded to discuss the law of appropriation of waters: "In all the Pacific coast states and territories * * * the doctrine of the common law, declaratory of the rights of riparian propriators respecting the use of running waters, was held to be inapplicable, or applicable only to a very limited extent, to the wants and necessities of the people, whether engaged in mining, agricultural, or other pursuits; and it was decided that prior appropriation gave the better right to the use of the running waters to the extent, in quantity and quality, necessary for the uses to which the waters were applied. This was the universal custom of the coast, sanctioned by the laws and decisions of the courts in the respective states and territories, and approved

and followed by the decisions of the Supreme Court of the United States."

The final case, from South Dakota, develops the history of irrigation rights still further and is well worth study. The court held that under the strict common law water for irrigation could not be diverted so as to "appreciably diminish" the flow as was held in the Pennsylvania case of Miller v. Miller and that the common law had been modified in California and some other states so as to allow for "reasonable" diversion for irrigation. The writer has not discovered any modern Pennsylvania case in point but is inclined to doubt whether eastern courts would now go beyond the "reasonable use" standard. The following case is well worth study.

Lone Tree Ditch Co. v. Cyclone Ditch Co., 15 S. D. 519. Opinion, March 1, 1902.

Facts: Both companies held riparian lands in South Dakota under patent from the United States under the Homestead law. The upstream owner had, the courts held, acquired his land prior to the time the predecessor of the plaintiff acquired his. The plaintiff, the lower riparian owner, had made an appropriation of water and was seeking to restrain the upstream owner from diverting water for irrigation of his land.

Decision: The courts held that as a riparian owner the upstream owner had a right to divert a reasonable amount of water for irrigation as when he acquired the land the downstream owner had not made an appropriation.

Opinion: The Supreme Court of South Dakota reviewed the history of the water laws of the state and compared them with those in other western states and with the common law.

Some interesting sections should be quoted: "* * * While owing to climatic conditions in Great Britain, where the common law as to riparian owners had its origin, and the Eastern states of this Union, where the common law governing those rights has been adopted, water for irrigating purposes was not usually required, still the common law seems to have recognized the right of the riparian owner to use a reasonable amount of water for irrigating purposes.

Elliott v. Railroad Co., 10 Cush, 193. 57 Am. Dec. 85. This subject was fully considered by the learned supreme court of California in an exhaustive opinion, in the important case of *Lux v. Haggin*, 69 Cal. 255, 10 Pac. 674, under proposition 15, on page 394, 69 Cal., and page 755, 10 Pac. The court in that case, speaking by Mr. Justice McKinstry, reviewed the English and American authorities, and arrived at the conclusion that at common law the riparian owner had the right to use the water flowing over or along his land for irrigating the same, and, in view of the fact that irrigation was necessary in order for the successful growing of crops in that state, the riparian owner had the right to use a reasonable amount of water of the stream for irrigating his land riparian thereto. In that state, as in this, two systems prevail: One for acquiring the use of water, for irrigating purposes, by appropriation; and the other, the common-law right to the use of water, not so legally appropriated for irrigating purposes, by the riparian owner. The rule as established in that state is more clearly stated in *Harris v. Harrison*, 93 Cal. 676, 29 Pac. 325, in which the court says: "But in some of

the western and southwestern states and territories, where the year is divided into one wet and one dry season, and irrigation is necessary to successful cultivation of the soil, the doctrine of riparian ownership has by judicial decision been modified or rather enlarged, so as to include the reasonable use of natural water for irrigating the riparian land, although such use may appreciably diminish the flow down to the lower riparian proprietor. And this must be taken to be the established rule in California, at least, where irrigation is thus necessary. *Lux v. Haggin*, 69 Cal, 10 Pac. 755. Of course there will be great difficulty in many cases to determine what is such reasonable use; and 'what is such reasonable use is a question of fact, and depends upon the circumstances appearing in each particular case.' The larger the number of riparian proprietors whose rights are involved, the greater will be the difficulty of adjustment. In such a case, the length of the stream, the volume of water in it, the extent of each ownership along the banks, the character of the soil owned by each contestant, the area sought to be irrigated by each—all these, and many other considerations—must enter into the solution of the problem; but one principle is surely established, namely, that no proprietor can absorb all the water of the stream, so as to allow none to flow down to his neighbor." In what is known as the Black Hills region in this state, similar conditions exist to those of California. Crops cannot be successfully raised in that section without irrigation. To hold, therefore, as contended for by the appellant, that the waters of a stream not appropriated prior to the acquisition of the right of the riparian owners must flow in undiminished quantity through the land of the various riparian owners, without the right to use the same for irrigating purposes, would in effect deprive them of the use of the waters of running streams, and cause great detriment to the settlers in that part of the country. It seems to us, therefore, that we may very properly construe the section we are considering in such a manner as to permit riparian owners to use a reasonable quantity of the water flowing over or along their lands for irrigating the same. Of course, no one riparian owner would have the right to divert all the water of a creek for irrigating his land, to the exclusion of all other riparian owners, and, as stated by the California courts, there is necessarily some difficulty in adjusting the rights of the various riparian owners so

that justice may be done to all. But as the court settling these rights passes upon the question as a question of fact, it will, after a full consideration of all the circumstances connected with the use of water of the stream, and the various rights of the different owners, be able to properly adjust these rights. Under this view of our statute, the rights of prior appropriators of the water of a stream are fully protected, and water not so appropriated may be properly used for irrigating purposes. In some of the states in the arid regions of the west, the courts hold that the common law is inapplicable, and therefore not in force. Such is the rule in Nevada *(Reduction Works v. Stevenson* [Nev.] 21 Pac, 317, 4 L.R.A. 60, 19 Am. St. Rep. 364); In Idaho *(Drake v. Earhart* [Idaho] 23 Pac. 541); in Wyoming *(Moyer v. Preston* [Wyo.], 44 Pac. 845, 71 Am. St. Rep. 914); in Colorado *(Hammond v. Rose,* 11 Colo. 526, 19 Pac. 466, 7 Am. St. Rep. 258); and Mr. Kinney, in his work on irrigation, states that the same doctrine is held in Utah, Arizona, New Mexico and Montana. But we are of the opinion that the doctrine as applied to the rights of appropriators and riparian owners by the courts of California, in view of the statute law of this state is the correct doctrine, and more consistent with our system of water rights. * * * "

(The second in a series of articles)

W&SW

Krause Director of Water and Sewerage Division, Business and Defense Services, Commerce Dept.

OATH OF OFFICE—Mr. Krause is sworn into office by Administrator Honeywell

The appointment of Charles W. Krause, of Glen Rock, N. J., as Director of the Water and Sewerage Industry and Utilities Division of the Business and Defense Services Administration U. S. Department of Commerce, was announced last November 30th by BDSA Administrator Charles F. Honeywell.

Mr. Krause, New York District Manager of the Neptune Meter Company, is on loan to BDSA from his company under a rotation system in which outstanding business executives serve the Government without compensation for periods of six months or longer. He succeeds Henry W. Hitzrot, of Westport, Conn., who is returning to his position as Special Assistant for Engineering Sales for The Dorr Company. Mr. Hitzrot, who has served with BDSA since last March, will continue his association with the agency as a consultant on matters pertaining to water and sewerage.

Mr. Krause, a native of New York City, has had more than 15 years' experience in the water works industry. The new Division Director received his early education in the public schools of Ridgewood, N. J. He obtained his mechanical engineering training at Pratt Institute in Brooklyn, and except for service during World War II with the Corps of Army Engineers, has been with the Neptune Meter Company continuously since 1938. Starting as a draftsman in the company's engineering department, he also served in the cost analysis section. He is a member of the American Water Works Association, and served as director of its Massachusetts section for two years.

Vertical Turbine Pump Assn. Elects New Officers

At its fall conference meeting, the Vertical Turbine Pump Assn. elected the following officers to serve during 1955:

President—Warren L. Bremer, Vice-President, Layne & Bowler Pump Co., Los Angeles, Calif.

Vice-President—William H. Reeves, Vice-President, Layne & Bowler, Inc., Memphis, Tenn.

Secretary-Treasurer—B. A. Tucker, Sales Manager, Peerless Pump Division, Food Machinery and Chemical Corp., Los Angeles, Calif.

The next conference of the Association will take place in February 1955, in San Francisco, Calif. Executive Manager of the Vertical Turbine Pump Assoc. is H. De Voe Rea.

Some Records in Weather

Here follows some weather extremes for the United States, as given in "The Old Farmer's Almanac" (163rd edition) for 1955.

TEMPERATURES

Lowest: 69.7 below zero at Rogers Pass, Mont., Jan. 29, 1954.

Highest: 134 degrees in Death Valley, Calif., July 10, 1930.

WIND VELOCITIES

Highest: 231 mph. at Mt. Washington, N. H., April, 1934.

PRECIPITATION

(Includes snow and rain, in which ten inches of snow is productive of one inch of water. Avg. annual for U. S. about 29 inches.)

Driest State: Nevada, average of 8.8 inches for the year.

Driest Spot: Greenland Ranch in Death Valley, Calif.—average 1.35 inches.

Wettest State: Louisiana, average of 55 inches for the year.

Wettest Spot: Wynoochee Oxbow, Wash., with 13 yr. average of 150.1 inches.

Max. Rainfall in 24 hrs.: New Smyrna, Fla., 23.22 in., Oct. 10, 1924.

Max. Snow in 24 hrs.: Giant Forest, Calif., 60 inches.

Largest Season's Snowfall: Tamarack, Calif., 884 in., 1906-07.

Largest Hail Stones: Potter, Neb., 1.5 lb. stones, July 6, 1928.

W&SW Technical Digests

Biological and Chemical Problems in a Shallow Reservoir

by G. U. HOUGHTON, Ph.D.

Mr. Houghton is chemist and bacteriologist, South Essex Waterworks Co. Langham, Colchester, England. His paper was presented at the 1954 annual general meeting of the British Society for Water Treatment and Examination. The data presented are of general interest and applicability. This digest of the paper is printed with permission of the Society.

IN ANY water supply scheme where the construction of an impounding reservoir is contemplated it is desirable to be able to make some forecast as to the probable biological and chemical behaviour of the water during storage. This applies particularly in the South of England where, as is well known, surface waters are especially prone to give trouble by reason of algal or other biological growth.

At the present time a number of impounding reservoirs are under construction in this country and the behaviour of new reservoirs is therefore a subject which has topical interest. Under these circumstances it was felt that it would be of value to give an account of some biological and chemical observations made during the early life of a large impounding reservoir in Essex. This reservoir, the Abberton reservoir of the South Essex Waterworks Company, has now been in service for some 13 years. A feature of the reservoir is its shallowness, average depth being only some 17 ft. while, with the reservoir full, over 50 per cent of the water in store is in the top 10 ft. The total capacity of the reservoir is 5659 mg with a nominal retention period of the order of 1 to 2 years.

Biological Experience at Abberton

Plankton crops of considerable magnitude are at times apt to be present in the stored Abberton water though they never give rise to taste or odour troubles and rarely or never give serious difficulty in the treatment of the water by double sand filtration. The general picture to date has been of a normal spring diatom pulse, sometimes starting as early as January or February and lasting until April. During this season filter head-losses do sometimes increase sharply and the runs of the beds are shortened but very seldom to any unmanageable extent. Counts of diatoms in autumn have always been much lower than in spring while in early summer the water has almost invariably contained little plankton.

Growth of Aquatic Weeds

Any report as to weed growth in a reservoir is necessarily unsatisfactory since, for obvious reasons, it is impossible to assess the growth quantitatively, reliance having to be placed on visual observation. Filling of the reservoir proceeded during 1940 and 1941 but some two years elapsed before growths of rooted aquatic weeds became well established. In the summer of 1942 and 1943 visible growths were very extensive, particularly in shallows where the top soil had not been stripped.

In 1944 a change was observed. In the early summer of that year *Chara* began to appear and there were considerable growths of that organism in the shallows for the next 4-5 years. During 1949-50 wide marginal areas were exposed for many months and the attached *Chara* more or less completely dried out, the marked white deposit of chalk on the growths being very apparent.

Source of Plankton Nutrients

It appears to the author that there is a strong presumption that plankton growths in the reservoir have only been dependent to a minor degree on direct autotrophic assimilation of inflowing nutrients. If this is so the corollary would be that in years when growth was abundant it was relying on fertility imparted by the reservoir site itself. There can, of course, be no doubt that when a reservoir site such as Abberton is first submerged the top soil and vegetation provide a rich source of inorganic nutrients, at least part of which will eventually be available for algal assimilation.

It may be pointed out that the decay of land vegetation, whether it imparts fertility by supplying inorganic nutrients or by providing soluble organic substances which can be utilised by algal heterotrophs, would probably have a more immediate and pronounced effect on productivity than would the leaching of nutrients from top soil. From the comparatively easily decomposable plant, extraction of nutrients into the surrounding water would be expected to occur much more readily than would the diffusion of nutrients from the clay soil constituting the reservoir floor.

If land vegetation offers algal nutrients in a particularly accessible form this would apply with even more force in the case of the decay of erect and rooted aquatic weeds. There is also the important difference that whereas the decay of the land vegetation is non-recurring, the aquatic plants will continue to grow each year for so long as the bottom is sufficiently fertile. The rooted aquatics would therefore seem to provide an ideal mechanism for the circulation of submerged soil nutrients into the supernatant water.

Fertility of Site Exhausted

A plausible interpretation of the biological sequences observed at Abberton would therefore proceed along the following lines. The Abberton site was mainly pasture and the only soil stripped was a small area around the periphery during the construction of the marginal works. Although some water collected over the lower contours was discharged to waste at the end of the constructional period, during 1941 much pasture was being submerged for the first time. The land vegetation thereon would have soon decomposed and the inference seems inescapable that this decaying organic matter, together with the inherent fertility of the soil, caused the initially high production of diatoms in 1941 and 1942 and of *Potamogeton* in the summer of the latter year. This low diatom productivity in 1943 is explicable as due to an exhaustion of nutrients, either as a result of the preceding heavy crops of diatoms or the extensive aquatic growths, or for both reasons.

The steady increase in spring diatom crop-size up to 1946 would then be explainable as a delayed secondary effect due to the slow decay of the early growths of aquatic weed and deposited plankton. It seems of much significance that during this secondary period growths of *Cyanophyceae* first appeared and reached a maximum for the whole 13 years. With the refilling of the reservoir in 1951 growth of *Potamogeton* and other aquatic plants set in again to a limited extent and it is to be noted that in 1953 a substantial increase in diatom production occurred, the plankton development being roughly comparable with that of 1948 before drought conditions occurred.

BOTTOM FERTILITY

"Whereas the decay of the land vegetation is non-recurring, the aquatic plants will continue to grow each year for so long as the bottom is sufficiently fertile."

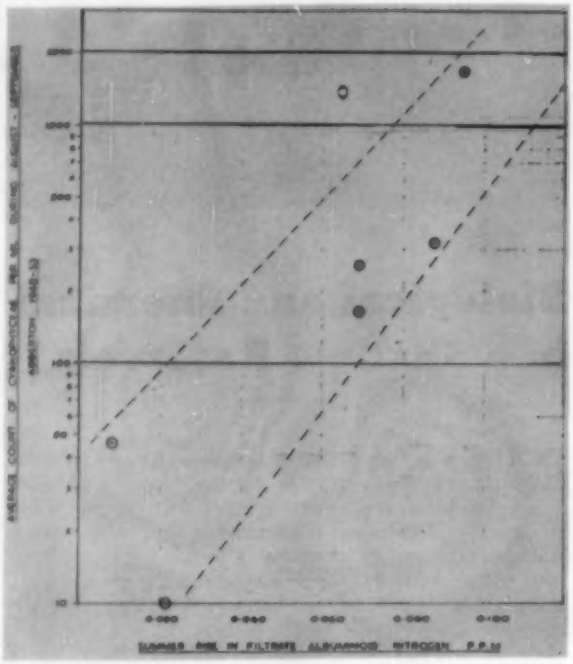
Long Storage Affects Nutrients

It therefore appears that the general biological situation at Abberton could be summed up as follows:

1. There can be little doubt that the initial burst of diatom productivity and aquatic weed growth mainly resulted from fertility imparted by the submerged pasture land: this was followed by a secondary peak of production, including both *Diatomaceae* and *Cyanophyceae*, after which a marked decline was apparent. Growths of autumn diatoms were negligible after the first few years.

2. In several later years the influent nutrients were unable to support more than a limited algal flora but there is no reason to think that in these years the inflowing water was abnormally poor in plant nutrients. Rather, it would appear that the effect of such nutrients was offset by the long storage.

3. By inference, the probability would seem to be that in years when algæ were relatively abundant their nutritional needs were being sustained by the decay of organic material native to the reservoir site, particularly aquatic weeds. Such an hypothesis would explain the marked secondary peak of production which was observed. If this is so it would mean that after 13 years the algal flora is still to some extent, and possibly to a large extent, dependent on the original site fertility.



RELATIONSHIP between Cyanophyceae and albuminoid nitrogen in reservoir

Reservoir Site Preparation

In constructing a new reservoir the question invariably arises as to what is necessary in preparing the site prior to impounding. Such preparations are mainly aimed at minimising biological growth, assuming of course that all possible precautions have been taken to safeguard the reservoir from a hygienic point of view.

Easily decomposable vegetation should, as far as possible, be removed and the possibility of soil-stripping should also be explored. It is obvious that in view of the very long life of a reservoir every practical step should be taken to ensure a "clean" site since the effect of nutrient material in a reservoir may apparently be felt for many years ahead. Such preparations are of course very expensive with a big site and in practice economic considerations will usually limit what can be done.

As to soil-stripping it has to be remembered that where the water is shallow stripping may have the corresponding disadvantage that exposed subsoil, particularly if clay, is easily disturbed by wave action and turbid water can result. This effect is at times very marked at Abberton where soil was stripped round the margin and over a small island that exists in the reservoir when levels are low. It would appear therefore that stripping is best practised where water depth will be greatest and wave action least marked.

The value of concrete marginal protection works is a somewhat debatable point, particularly as they are so costly. They were constructed at Abberton and they do give the advantage of a clean peripheral strip while minimising disturbance of bottom by wind action. This especially applies where the contours would otherwise result in very shallow water and where the margins, if unstripped, would be ideally suited to the development of marsh and aquatic plants. It is indeed clear that each site presents its own peculiarities and that its preparation and protection have to be decided accordingly.

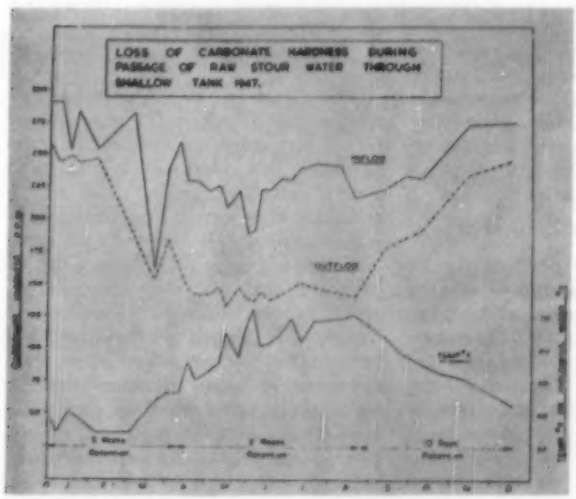
Carbonate Hardness Reduction

In an earlier account as to Abberton reservoir reference was made to the marked loss of carbonate hardness which was consequent upon the storage of the water. This loss is a regular feature at Abberton although the reduction in hardness observed varies from year to year. Thus over the three years 1947-49 the computed average carbonate hardness of the impounded water, assuming 15 per cent from the Layer Brook, was 225 ppm whereas the average figure for the water leaving the reservoir was only 124 ppm, a removal of 101 ppm: this may be compared with a computed removal of only 60 ppm in 1942-44. The removal of hardness is highly seasonal, decrease in hardness setting in at the end of the main impounding period (May) and continuing so as to give minimum hardness figures in September—October.

In recent years there have been two further reports as to marked removal of carbonate hardness. Hornby has recorded a loss of 78 ppm in Cheddar reservoir and Whitehead one of 70 ppm in Shustoke reservoir. It is important to note that in all these cases the reservoirs are relatively shallow, the average depths at Abberton and Cheddar being 17 ft. and 16 ft. respectively while at Shustoke maximum depth is 22 ft. with much water under 10 ft. in depth. It may also be pointed out that this natural softening of the water is a valuable economic attribute of the reservoir: particularly is this so if the undertaking is required to soften the water since the natural hardness removal will lead to considerable savings on softening chemicals as well as some reduction in other softening costs.

Mechanism of Natural Softening

The mechanism by which natural softening occurs is of importance and there can be no doubt that in some circumstances it is partly a biological effect. It is well known that in the absence of free carbon dioxide algæ can utilise carbon dioxide from bicarbonate during photosynthesis and, for instance, there is the familiar phenomenon of the deposition of calcium carbonate on growths of *Characeae*. Reference may also be made to the possibility of calcium carbonate being deposited on account of bacterial action in bottom muds (*vide* Harold 1937). As to physico-chemical effects there is the well-established disruption of bicarbonate during aeration and its possible disruption during evaporation.



VARIATION in carbonate hardness with retention period

The transformation of calcium bicarbonate to calcium carbonate which occurs when hard water is exposed to air is, of course, well recognised. The system (bicarbonate—free carbon dioxide—atmospheric carbon dioxide) will always tend towards a dynamic equilibrium for a given water and under equilibrium conditions there will be for every temperature and partial pressure of gaseous carbon dioxide a fixed alkalinity and *p*H value. In 1915 in his paper dealing with the solubility-product of calcium and magnesium carbonates, Johnstone used Schloesing's data and those of Engel (which were in agreement) to calculate the solubility-product of calcium carbonate and therefrom the equilibrium alkalinity corresponding to the carbon dioxide content of normal air: the value thus obtained was 63 ppm of $CaCO_3$ at 16°C.

SOFTER WATER

"Natural softening of the water is a valuable economic attribute of the reservoir: particularly is this so if the undertaking is required to soften the water."

It is also of interest to note that the minimum alkalinity recorded at Abberton was, at 55 ppm in 1950, not far removed from Johnstone's value. On this basis therefore, any hard water with over about 63 ppm of total alkalinity will, when exposed to air, tend to deposit chalk. Conversely, if under 63 ppm of alkalinity is present the water will, if in contact with calcium carbonate and atmospheric air, tend to increase in alkalinity towards the equilibrium value.

Time and Depth Factors

It will be appreciated from the above considerations that loss of carbonate hardness in a body of water such as a reservoir will be particularly dependent on two factors. Firstly, the natural softening will be facilitated by shallowness since this implies large surface area relative to volume and therefore maximum chance of loss of carbon dioxide across the water surface. In a deep reservoir such loss can obviously not proceed in the lower strata of water and so long as this lower water contains a small excess of free carbon dioxide—as might be maintained by bacterial respiration—production of normal carbonate can only proceed to a limited extent, if at all. Secondly, the retention period must be long enough to permit the whole gradual process to proceed viz. loss of carbon dioxide, desaturation of normal carbonate and subsequent deposition of chalk.

It is quite understandable that the three reservoirs mentioned above, where natural softening is very marked, should all be comparatively shallow ones and, at any rate in the case of Abberton, offering long retention. No doubt temperature and other factors also play a part and it will be noted that the Abberton hardness removal is at a maximum in late summer when the water is warmest. It is evident that the whole process of natural softening at Abberton and elsewhere can readily be explained on physico-chemical grounds. It may well be, however, that biological mechanisms are also involved and in this connection it would be of interest to hear of any case where comparable losses of hardness occurred where hard water was stored for a long period in a deep reservoir. Under such conditions loss of carbon dioxide across the air-water interface would be minimised, as would non-biological disruption of bicarbonate.

EXHIBIT A: Tuberculation of a 6-inch main which cost a lot in extra power to force water through.

How Pipe Line Cleaning Saves Money

by GEORGE G. ELLIS

Mr. Ellis is engineer with the Flexible Pipe Cleaning Co. of Los Nietos, California. **He presents arguments for cleaning water mains, both for improving the quality of water service and as an economy measure. In this day of growing per capita water demands, and increasing replacement and operating costs, these considerations cannot be overemphasized.**

THE future of many parts of this great country, with its abundant natural sources of water and power for industrial and agricultural expansion, will be paced by the degree to which sound, far-sighted planning of water supply and its distribution is made. Admittedly, "big business" investment in this country's water systems reaches today to the impressive figure of seven and one half billion dollars. Investigation discloses that more than one-half of this tremendous sum lies in transmission and distribution lines—i.e., pipe lines.

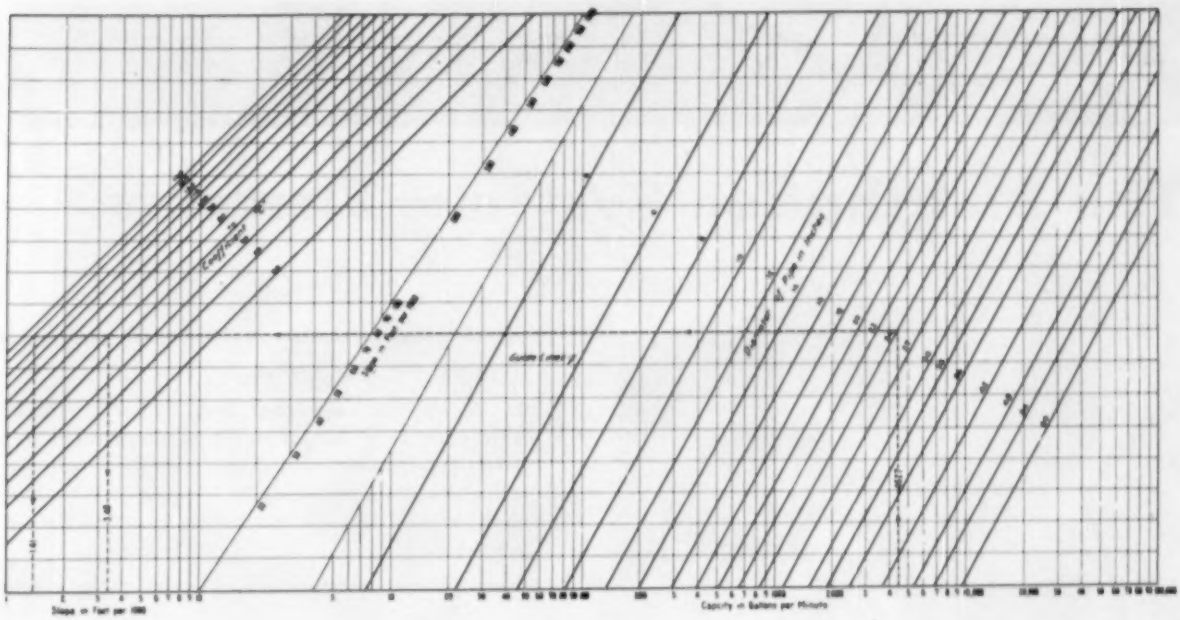
To meet the increasing demands of a growing population, to meet the problem of water rates, often inadequate, engineers today are giving more thought to preservation of existing pipe lines as well as means of constructing new lines at economies consistent with efficiency. Prior to World War II, water systems were built at an approximate cost of $60.00 per capita, but by 1954 this cost has risen to about $150.00 per capita. With the high cost of replacement, and the public's resistance to increased rates, municipalities are searching for ways of increasing the longevity of existing pipe lines. Here it is essential to bring to light one of the most damaging and destructive factors affecting operational costs of pipe lines. Generally given far too little recognition, that factor is the natural process known as tuberculation.

Tuberculation and Its Effects

Tuberculation, a by product of corrosion, involves a buildup of oxides and other insoluble salts within pipe lines. It is analogous to arteriosclerosis in the human blood vessels, relating to a tubercle or outgrowth within pipes. These dangerous deposits narrow the free space within the main by taking the form of impenetrable "bumps" firmly attached to the inside walls of the pipes.

The effect of such narrowing and roughening of the inside pipe diameters is to retard or hamper the flow of water. It is therefore necessary to greatly increase pressure to secure adequate flow, or the flow that a pipe line with original smooth interior walls would give. This increase of pressure can only be obtained by spending ever-increasing amounts of money for pumping facilities and power. Beside the marked increase in operating costs, tuberculation lessens the useful life of existing water distribution facilities, thereby necessitating costly and wasteful replacements.

The most striking example of the



Example - Flow = 4527 G.P.M. Through 24" Dia. Pipe for C = 130 Loss = 1.41 for C = 80 Loss = 3.48

FLOW OF WATER IN PIPE

HAZEN - WILLIAMS FORMULA

$V = CR^{0.63} S^{0.54} 0.001^{-0.04}$

cost of inefficient pipe lines, because of tuberculation, is in the lessening of fire fighting effectiveness. Inadequacy of water distribution systems is the third largest factor contributing to losses from conflagrations. Fires cost this nation 12,000 lives and $780,000,000 in property each year. Insurance companies recognize this point by rating adequate water systems as of even greater importance than the efficiency of fire departments.

What Tuberculation Control Means

Let us look at some of the positive aspects of controlling this common problem of tuberculation. For this evaluation, the Hazen and Williams diagram shown here is extremely helpful. It enables the user to obtain accurate answers to questions raised by the four conditions accompanying the chart, and without the need for making detailed computations. A common situation in many water departments is a reduction in amount of flow through established lines. This chart enables analysis of the factors affecting water flow.

What the Chart Will Reveal

1. It is possible to determine the "C" value necessary to be maintained for any size of pipe and any given quantity of flow (gpm) where the slope, or head, in feet per 1000 ft of main is known.
2. The diagram indicates, for any size of pipe, how much the slope, or head, must be increased to overcome frictional resistance (shown as a reduction in "C," caused by tuberculation in the pipe line) in order to maintain any given rate of flow.
3. The reduction in "C," resulting from increased frictional resistance in those instances where the slope or pressure head remains constant, can be used as a check item in determining the extent to which the carrying capacity of any given size pipe has been reduced.
4. Where flow (gpm) and pressure head (ft) has been determined by measurement, the diagram will disclose the value of "C," the coefficient of free flow. Comparison of "C" value with the coefficient "C-1," for new pipe will indicate the extent of tuberculation.

An Example

For an example, a transmission line 24 inches in diameter and 1 mile long is designed to carry 4,527 gpm. With a "C" value of 130, it was found necessary to purchase pumps to overcome the static lift and only 7.44 feet of frictional resistance. Several years of service reduced efficiency in the line, with "C" dropping to 80. This drop, which was due to tuberculation, increased resistance by 10.93 feet to 18.37 feet, and necessitated a substantial increase in power to pump the 4,527 gpm required. The cost of this greater energy needed is $1,100 per year, which sum is more than it would cost to clean the line and restore it to substantially original condition. Cleaning makes unnecessary for some years any increase in power cost and keeps the pipeline efficiency high.

Solution of the Problem

Tuberculation makes replacement of equipment necessary at frequent intervals as well as increasing operating costs for poorer service. Many thousands of miles of pipe now installed are requiring replacement, after years of bad output, because they suffer from clogging by tuberculation. These costs and losses could be markedly reduced by cleaning of pipes.

Cleaning is no panacea. It is merely one step, but a most important one, in tackling the problem of water transmission and distribution. In new lines, proper treatment of the water will *prevent* tuberculation. In existing lines, wherein miles of pipe have been detrimentally affected, water treatment is ineffective. The proper answer is two-fold: clean existing pipe, thus restoring it as nearly as possible to its original flow characteristics, and then treat the water in a manner to effect control, or suppression of tuberculation.

The Distribution System—Elements

The Eighteenth in a Series

by GEORGE E. SYMONS, Ph. D.

Dr. Symons is Consultant and Technical Editor, Larchmont, N. Y. In this series he discusses *Water Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

AFTER water has been procured, and treated if necessary, it must be transported to the point of use. The system used for placing water at the customer's faucet is called the distribution system. It consists not only of piping but several other elements all of which are discussed in this lecture.

A . . . The Distribution System

1. HISTORY

a. It has been said that piping, or the closed conduit, is the fourth most important discovery of mankind. (First three: Fire, the wheel, the lever.)

b. The origin of pipe is not known but it appeared in many places, at varying times long before the birth of Christ.

(1) Egyptians used copper pipe in 3800 B.C., and about the same time, probably, the Chinese used hollow bamboo poles to pipe gas from wells to fires for evaporating salt water to obtain salt.

(2) Tile drains were included in near-east palaces in 2500 B.C. and King Minos of Crete in 2000 B.C. built a palace with tile water and sewer lines.

(3) By 1500 B.C. King Solomon in Jerusalem and many Greek cities had extensive water systems.

(4) Roman aqueducts built between 330 B.C. and 90 A.D. had a capacity of 332 mgd and used lead service connections.

(5) By 450 A.D. there were many piping systems but by 750 A.D. all had disappeared. Rebirth of piping came in the 14th century along with the development of cast iron cannon.

(6) Early water pipes in England and America were bored logs; the first cast iron pipe in England was laid in 1774, and the first cast iron distribution system in America was laid in Philadelphia in 1802.

2. ELEMENTS

a. There are several parts to a complete distribution system, although not all systems make use of all of these parts, which are:

Distributing Reservoirs
Conduits or Transmission Mains
Distributing Mains

b. Accessories to distribution systems include:

Booster stations
Valves
Hydrants
Main Line Meters
Service Connections

c. Distribution may be by gravity, by pumps with storage, or by pumps alone. In the latter case pumps deliver directly into the mains without benefit of tanks or reservoirs floating on the system.

3. IMPORTANCE

a. Without pipe and its accessories, our society and economy would be impossible.

b. As a transportation system, pipe lines in water works handle a greater tonnage of product delivered than any other transportation system.

c. Approximately 66 per cent of the total value of the average water works is in the distribution system.

(1) Approximately 80 per cent of the distribution system value is in mains and valves.

(2) The weight of cast iron pipe in distribution systems will approximate 275 to 300 tons per 1000 population.

B . . . Distributing Reservoirs

1. FUNCTION

a. Primary purposes and advantages of distributing reservoirs are:

(1) To equalize hourly or daily flow

(2) To provide and maintain desired pressure in remote areas

(3) To provide emergency storage for fire protection purposes

b. Secondary benefits of distributing reservoirs

(1) Equalizes pumping heads which permits selection of pumps of highest efficiency.

(2) Permits economies of construction by making it possible to reduce size of pumps and mains necessary to furnish a district since peak rates on the pumps are diminished by the reservoirs.

(3) Permits economies of operation

. . . Through operation at constant rates

. . . By one-shift or two-shift operation

. . . By pumping during off-peak power periods when power rates are low.

(4) Reduces fluctuations in pressure and avoids interruptions in service during repairs to mains.

c. In gravity systems, one or more distributing reservoirs maintain desired pressure and serve as available supply in case of supply main break.

2. LOCATION AND DESIGN

a. Distributing reservoirs may be classified:

(1) With respect to ground surface

. . . Ground storage—at or below ground level

. . . Elevated storage—above ground level

(2) With respect to material of construction

. . . Steel, reinforced concrete, wood,

MODERN design and camouflage of distribution storage standpipe.

earth

(3) With respect to design in the case of elevated storage:

. . . Standpipes

. . . Elevated tanks

b. Location of distributing reservoirs should be:

(1) At a point near the center of consumption, or near areas where improvements in pressures are needed.

(2) On ground high enough to maintain desired pressure.

(3) On a site that gives the greatest advantages at lowest construction costs.

c. Design Considerations

(1) Ground Storage

. . . May be earth reservoir of cut and fill type, or of reinforced concrete and masonry.

. . . If not too large, it should be covered to prevent contamination and infestation of algae and other biological growths.

. . . Ground storage preferably has an inlet and outlet at opposite ends or sides to provide circulation, with the outlet near the bottom. Overflow and drain pipes are also provided and all pipes are valved.

(2) Elevated Storage

. . . Standpipes may be of steel, reinforced concrete or timber. In all cases they should be covered.

. . . Standpipes are used where practically all of the water contained is above the lowest level that is effective for storage purposes. They are usually less than 40 ft. high; height is often limited by economic considerations. In the newer concrete tanks the more economical prestressed construction is being employed.

. . . Elevated tanks may be of steel, reinforced concrete or timber.

. . . Various shapes of tanks are available, the shape bearing some relation to the capacity. Heights depend on pressure required. Water enters and leaves the tank through a single riser pipe.

. . . Specifications for standpipes and elevated steel water tanks may be obtained from the Am. Water Works Ass'n.

(3) Architectural design in modern tanks adds to their attractiveness.

3. Capacity

a. Distributing reservoirs are generally relatively small.

b. Actual capacity depends on:

Maximum rate of consumption
Maximum pumping capacity
Minimum safe yield of source of supply
Fire flow requirements

c. Reserve storage for fire protection emergency must be provided if pumping capacity is not sufficient to meet the requirements for fire flow as set by the Nat'l. Bd. of Fire Underwriters (N.B.F.U.).

(1) The N.B.F.U. recommends that the rate of fire flow to be supplied to a community, in addition to regular usage, shall be related to population by an empirical formula

$$GPM = 1020\sqrt{P} \times (1-0.01\sqrt{P})$$

where P = Population in Thousands

(2) The N.B.F.U. requires that such fire flow must be available for 10 hours in cities of 6000 and more, and from 4 to 9 hours in communities of 1000 to 5000.

(3) The N.B.F.U. requirement is indicated in Fig. 1, wherein both gallons per minute and total gallons required are shown in relation to community size.

. . . The fire flow storage requirement would be the difference between the volume revealed by the curve in Fig. 1 and the total pumping output capacity in the number of hours specified.

d. Figure 2 is a curve developed by Chas. B. Burdick, based on a study of five communities. It shows the amount of storage necessary in a maximum day to reduce the pumpage to a constant rate throughout the 24 hours.

. . . Table 1 is similar to one by Burdick for calculation of rates of pumpage and storage in cities of various sizes, except that the basic values are somewhat different.

e. Another approach to sizing of flow and storage capacity is shown in Fig. 5 in an earlier lecture on "Design Criteria, Part II."

f. Reservoirs float on the system.

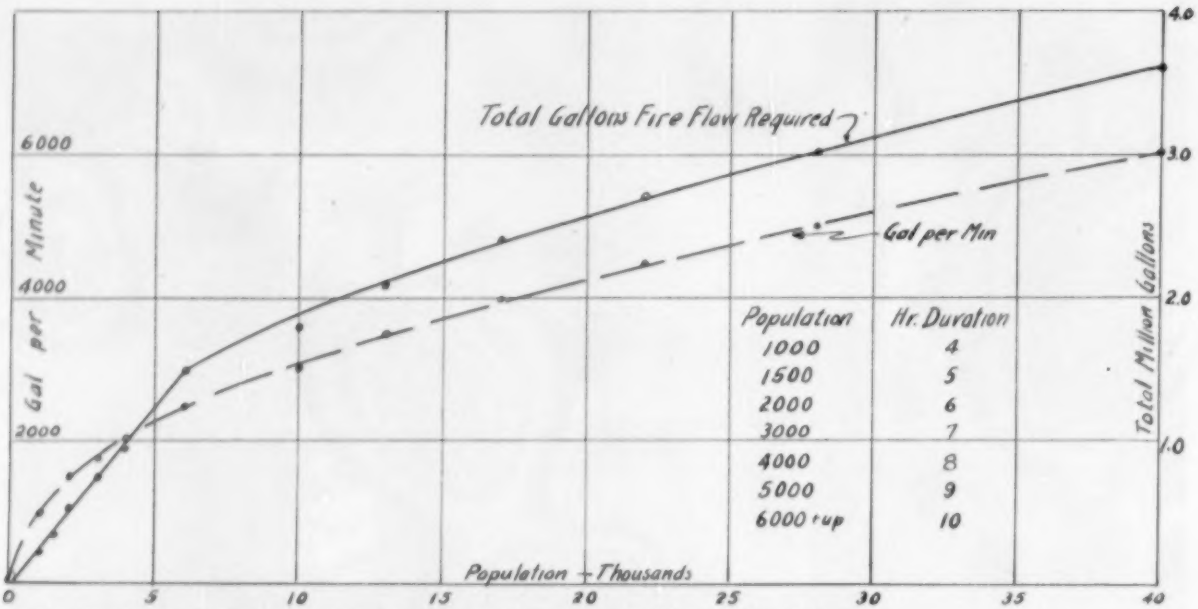


Fig. 1—Fire-flow requirements for cities of various populations—National Board of Fire Underwriters.

With pumps operating at average rates, the storage tank for reservoir fills or empties depending on whether or not the rate of consumption is above or below the pumping rate.

C . . . Conduits and Transmission Mains

1. Classification

a. Water is transported from source or pumping station to the distribution network, by gravity conduits or open channels, or in pressure conduits called transmission mains.

b. Gravity conduits may be canals, flumes or aqueducts.

c. Pressure conduits may be of cast iron, steel, reinforced concrete, asbestos-cement or wood stave.

2. Location and Design

a. When possible, conduits and transmission mains usually take the shortest route to the distribution network.

b. Depressions and peaks should be avoided, insofar as possible, in order to avoid high pressure at depressions and the need for air relief valves at peaks.

c. Transmission mains are often laid along highways to avoid right of way costs, but the location of water mains in highways may necessitate a later expenditure for re-location when highways are widened, regraded or moved.

d. Size of transmission mains should be based on estimated capacity required 25 years hence. Twin lines are often used for protection in case of failure and to allow for inspection, cleaning, repair, etc.

D . . . Pipe Lines and Networks

1. Materials

a. Pipe lines may be:

(1) Cast iron, which is very durable (many cast iron pipe systems are more than 100 years old.)—Cast iron can be conveniently cast in any form, but its tensile strength is low and the pipe wall must be thick. Cast iron, unless lined with cement or bituminous coating, is subject to tuberculation.

(2) Reinforced prestressed concrete; used in the larger sizes.

(3) Asbestos-cement, which is light weight and corrosion resistant.

(4) Steel, which finds use in sizes larger than 36 in.

(5) Wrought-iron, which is used in the smaller sizes for special situations.

(6) Wood stave held by steel or wrought iron bands. Used mainly for irrigation work industrial supplies, and temporary installations

b. Coatings are used in metal pipes to prevent corrosion and loss of carrying capacity

(1) Most common is a bituminous commonly called coal-tar-pitch varnish, or bituminous tar. Pipes so treated are called tar-dipped.

(2) Cement or bituminous lining may be added, during manufacture, to cast iron pipe. Cement linings can be added to pipe in place by special methods.

c. Joints for pipe depend on type of pipe

(1) Cast iron pipe joints may be bell and spigot, flanged, universal, mechanical and flexible ball. Mechanical jointed pipe is becoming more and more popular.

(2) Concrete pipe uses a rubber ring in an offset joint forced together, under tension.

(3) Asbestos-cement pipe uses a rubber ring on a tapered end with a joint covered by a sleeve which holds the rubber ring under compression.

(4) Cast iron pipe joints in bell and spigot pipe may be sealed with

Table 1

Rates of Flow Required in Cities of Various Sizes

(After Burdick)

Population	MGD at 140 gpcd 100%	MGD probable max day 150%	MGD probable hourly peak 300%	MGD max rate for fire protection	MG storage for hourly peak 20% of max day
1,000	0.14	0.21	0.42	1.44	0.04
2,000	0.28	0.42	0.84	2.16	0.08
4,000	0.56	0.84	1.68	2.88	0.13
10,000	1.40	2.10	4.20	4.32	0.42
28,000	3.92	5.88	11.76	7.20	1.17
60,000	8.40	10.60	21.20	10.08	2.12
100,000	14.00	21.00	42.00	12.96	4.20
200,000	28.00	42.00	84.00	17.28	8.40

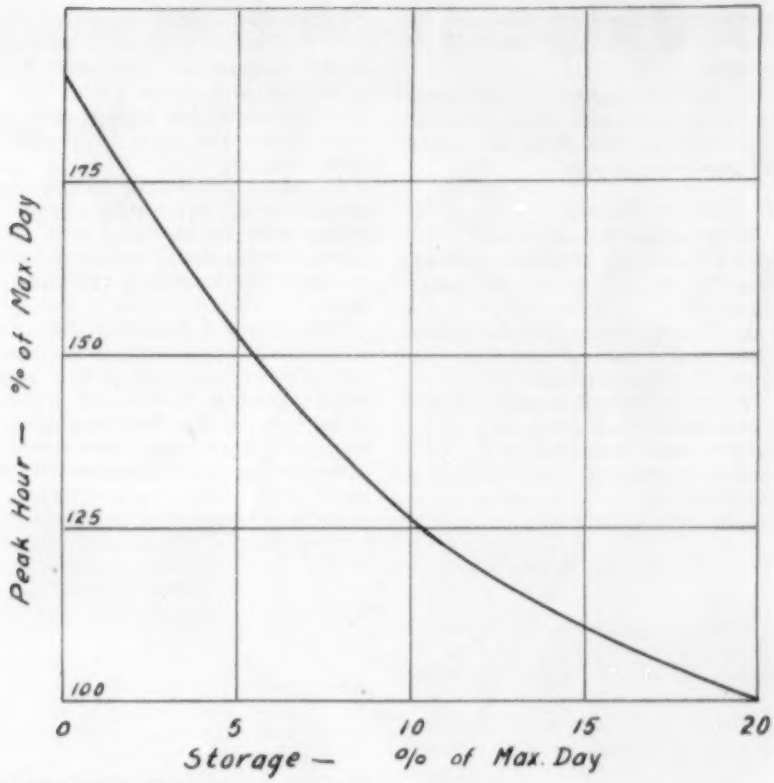


Fig. 2—Storage effects on pumpage peaks
Expressed in percent of max. 24 hr. pumpage on maximum demand days—(after Burdick).

lead or sulfur joint compounds poured hot against a packing ring of jute, braided paper or rubber.

d. Fittings for all kinds of pipe include: Curves or ells (22½ deg., 45 deg., and 90 deg.); reducers, tees, wyes, crosses, and sleeves.

2. NETWORK SYSTEMS

a. Components

(1) Supply Mains (also called transmission or trunk mains) carry water from source or pump station to sections of a city.

(2) Arterial Mains, or secondary feeders, connected to the trunk mains.

(3) Minor Distributors make up the grid of pipes between the secondary system and supply fire hydrants and domestic consumers.

b. Design

(1) Supply mains are large diameter pipes. If laid in duplicate they should be cross connected with each other at intervals of a mile or so, with mains almost as large, and equipped with blowoffs at low points and air relief valves at high points.

. . . Emergency interconnections with other potable supplies should be provided wherever possible.—If railroads or other barriers lie across the route duplicate supply mains should be laid.

(2) Arterial mains must be large enough for required fire flow plus the domestic requirements for the district.

. . . They should be in duplicate but not in the same street. It is better to lay two moderately large mains a few blocks apart, than to lay one single large main.

. . . They should be spaced about every 3000 ft on supply lines and should be looped.

(3) Minor distributors may be from 4 to 12 in. in size and should be interconnected at intervals of 1200 ft. or less.

(4) In general, minor distributors and arterial mains should not be laid to dead ends. It is better to tie them into grids or loops. Some systems are combinations of grids and dead ends.

. . . Fire hydrants should have no less than a six inch supply main.

. . . Four inch pipes (or even two inch non-tuberculating pipes) may be used for side streets where domestic consumption only is supplied, but these sizes are costly per unit capacity compared to larger pipe.

. . . Minor distribution mains should be of no less than 8 in. size in high value districts and spaced with cross mains every 600 ft.—12-in. pipe should be used on principal streets.

. . . N.B.F.U. recommends a minimum of 8-in. mains but permits 6-in. grids when the length between the cross connections is not over 600 ft.

. . . Table 2 shows the distribution of pipe sizes in eight cities as reported by Babbitt and Doland as compared with the entirely new city of Levittown, Pa. (population 70,000), built in three years between 1952-1955.

TABLE 2

Sizes of Mains in American Cities

Pipe Size (in.)	Per cent of total length of pipe (B & D*)	(Levittown, Pa.)
4	15-16	0
6	49-55	71.9
8	11-15	16.4
10	4-6	
12	7-8	7.5
14	2.2	0
16	2.6	3.1
18	1.2	0
20 & up	4-6	1.1

* From Babbitt & Doland, "Water Supply Engineering"

c. Booster stations, which are pumps taking water from a supply main and discharging it at a higher pressure to another point in the same pipe line, are used to increase pipe line pressure in outlying areas when loss of head is too great along the line.

(1) Booster stations may operate in conjunction with the filling of elevated storage tanks.

(2) Booster pumps may be controlled simply by pressure in the system or the elevated tank or they may be controlled by a combination of pressure and flow (Pressureflo Control), whereby pumps are actuated not only by the need to maintain pressure but also by the need to maintain flow.

E . . . Valves

1. LOCATION

a. Valves should be located on all branches from feeder mains and between minor distributors and hydrants.

b. Three valves are used at crosses on systems, two valves at tees; the valves are placed on the smaller lines at each location cross or tee.

c. Valves should be placed at least every 1200 ft on arterial mains and minor distributors, and closer in high valve districts.

2. TYPES

a. Shut off may be accomplished by: butterfly valves, cone valves, and gate valves

b. Check valves are automatic valves which allow the water to flow in one direction only and to prevent back flow.

c. Back-flow preventers (special

types of check valves) are used where cross connections are made between a domestic and an industrial supply. Cross connections of this type are generally frowned on by health departments.

d. Altitude valves are used on elevated storage tanks. These are a type of check valve which shuts off flow into a tank when the elevation reaches a predetermined level, and opens when the pressure on the pump side is less than that on the tank side of the valve.

e. Air relief valves are a type of check valve which will permit the escape of air (but not water) from high points on a line and will permit the entrance of air in case of a break which would create a vacuum in the line.

F . . . Hydrants

1. Location

a. Hydrants are spaced according to area to be served.

(1) The area is governed by population, district value, length of fire hose that can be served and method of obtaining the required fire pressure.

(2) The N.B.F.U. has tables showing areas to be covered by hydrants for different size cities.

b. In general, hydrants should be:

(1) From 2 to 6 ft from the curb or pavement.

(2) Three ft from fixed objects.

(3) With the lowest outlet at least 18 in above the ground and the highest operating nut not more than 48 in above the ground.

c. Circles drawn around each hydrant with a 200 to 300 ft radius should overlap, otherwise hydrants are too far apart.

2. Types of Hydrants

a. Most hydrants consist of a cast iron barrel with a bell or flange fitting at the bottom to connect to a branch from the water main, a valve of the gate or compression type with a long stem terminating in a nut above the barrel, and one or more outlets.

b. Hydrants are classified as one-way, two-way, three-way, or four-way according to the number of outlets. Most common is the hydrant with two 2½-in hose outlets and one 4-in pumper outlet.

c. Specifications for hydrants have been issued by AWWA.

G . . . Main Line Meters

1. Location

a. Meters for measuring flow in transmission mains are usually placed at the pump station to determine the flow of water actually entering the system.

b. Main line meters are also placed at points where one supply interconnects with another, either for regular or emergency service.

2. Types of Meters

a. Main line meters should be selected for high accuracy and low head loss in order to minimize power required for pumping.

b. Two important meters meeting these requirements are the Dall Flow Tube and Venturi Tube.

c. A complete discussion of flow measurement was given in a lecture on that topic. An article in Water & Sewage Works in April 1954 offers diagrams and tables to aid in the selection of main line meters.

H . . . Services and Service Meters

1. Services

a. Small pipes which connect the street mains to the house pipes are called service lines or just "services."

b. Services usually are small pipes from ¾ to 1½-in. in diameter and may be of galvanized iron, wrought-iron, red brass, copper, lead or plastic. Of late a number of cities and water companies have been using plastic tubing experimentally for service lines. From experience to date it appears highly probable that plastic pipe or tubing will become a generally accepted material for service lines.

c. Services are connected to the mains through a shut off valve called a corporation stop, or cock. In many communities the home owner lays and owns the service pipe where it crosses his property while the water utility owns that part under the street. A new practice is for the utility to place, own and maintain the service from main to house.

2. Service or Customer Meters

a. About 65 per cent of all customer services in the U. S. are metered. Universal metering in a community reduces water waste. Metering assures the utility of being paid for the water it pumps or distributes, since the customer pays for the water according to the amount used or wasted. For that reason meters have been termed the "cash register" of the water utility.

b. Service meters may be of three types: Nutating or wobbling disk, oscillating piston, and turbine. The first two operate on the fill and draw (displacement) principle of flow measurement; the third is a velocity type meter.

c. Meters may be placed at the curb line, in the customer's yard or in the basement of his house. The latter location is better where freezing might occur, but modern outdoor meter boxes also offer protection from freezing.

d. Meters are usually owned and installed by the water utility; in some communities the customer owns the meter or pays rental service charges and must pay for testing and maintenance.

e. For large consumers, where the flow varies over a wide range, compound meters are used, with a large meter on the main line and a small meter on a by-pass line for measuring small flows, with an automatic valve to direct low flows through the small meter. Also "battery meters," involving setting of 2 in meters in tandem, with weighted check valves to force low flows through one of the meters in the "battery," have been employed to obtain positive registration of the low flows.

f. Fire flow meters are used on lines serving factories for fire service. In effect they are a type of compound meter, so arranged to indicate any consumption of water at low flows, as well as large drafts in case of fire.

A Correction

Cone Valves Create Less Head Loss Than Gate Valves

The following correction should be made to my lecture in the October issue.

Under Section C, 1 on page 435, of the lecture on "Loss of Head", the paragraph should read as follows:

d. Loss of head values increase with an increase in velocity of flow.

e. Loss of head values differ for each type of valve. In general, the relative loss of head (in descending order) for valves of the same size at the same velocity of flow will be in this order: Globe valve, angle valve, swing check valve, butterfly valve, gate valve, cone valve.

In short, the globe valve has the highest loss of head and the cone valve the lowest.

References

Material for this lecture was obtained from these sources:

Howson, L. R., "The Distribution System," *Wat. Wks. & Sew.*, Dec. 1943.

Burdick, C. B., "Storage on the Distribution System," *Wat. & Sew. Wks.*, July 1947.

Kiker, J. E., "Computing Requirements for Elevated Water Storage," *Pub. Wks.*, May 1953.

Babbitt & Doland, "Water Supply Engineering," McGraw-Hill Book Co.

Hardenbergh, W. A., "Water Supply and Purification," Int. Textbook Co.

Steel, E. W., "Water Supply and Sewerage," McGraw-Hill Book Co.

NEXT LECTURE . . . The Distribution System — Part 2, Operation

How to Make a Simple Loss-of-Head Gage

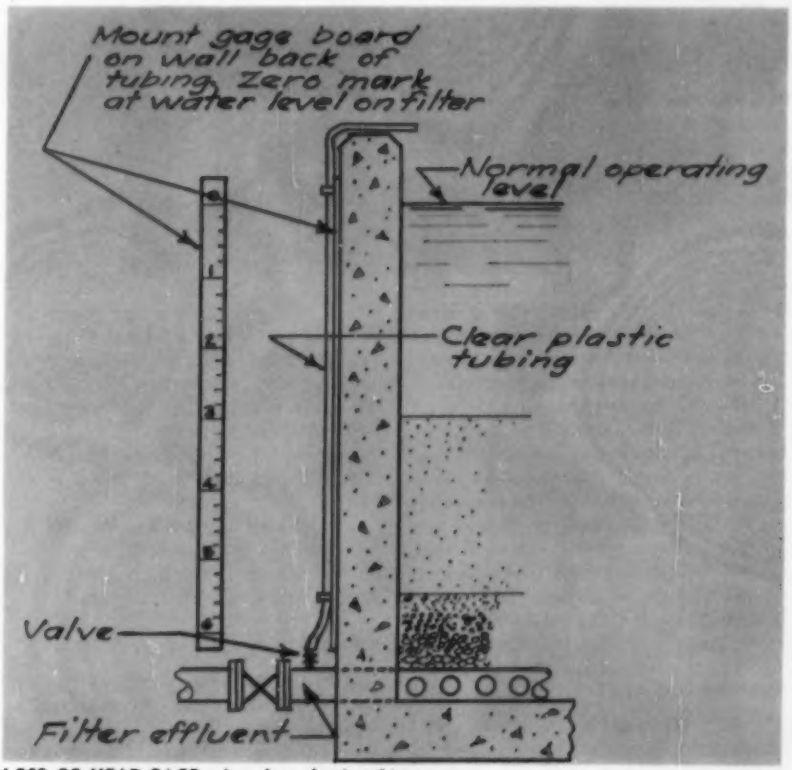
by H. K. GIDLEY

IN OLDER water filtration plants, particularly in small plants, one often finds gravity filters operating without loss-of-head gages. The accompanying sketch illustrates how a simple but dependable loss-of-head gage may be added.

Drill and tap the filter effluent line between the filter wall and the effluent control valve, to insert a short length of ¼-in. or ⅜-in. pipe or tubing equipped with a valve. Connect an appropriate length of transparent plastic tubing (plastic garden hose will do) to the pipe stub. Run the plastic tubing vertically upward and over the top of the filter wall so that the open end discharges into the filter. A screen should be fastened over the open end.

The end of the plastic tubing must not be submerged in the water on top of the filter, or terminate at a point where it can become submerged, in order to prevent unfiltered water ever being siphoned into the filtered water. The tubing should discharge above the filter as water will issue from the open end when the filter is backwashed, unless the valve on the loss-of-head gage is closed.

Mr. Gidley is Director, Division of Sanitary Engineering, State Department of Health, Charleston, West Virginia


Mount gage board on wall back of tubing. Zero mark at water level on filter
Normal operating level
Clear plastic tubing
Valve
Filter effluent

LOSS-OF-HEAD GAGE using clear plastic tubing

On the filter wall back of the plastic tubing mount a gage board, graduated in feet and tenths of a foot. The zero mark on the gage must be on a level with the normal water level on the filter. If the operating level of the filter varies appreciably, install a short gage board on the inner side of the filter wall. By means of the inner gage board, any departure from the zero level point can be observed, and the deviation added to or subtracted from the reading on the outer gage.

When the filter is operating, the height of water in the plastic tube will drop to a level below the level of water in the filter and the vertical distance between the two levels is a true measure of the loss of head. When clean, a gravity sand filter of standard construction operating at a rate of two gallons per square ft. of sand area per minute will show a loss of head of 1.0 to 2.0 feet. As a filter operates the sand becomes clogged and the loss of head increases. A measure of the loss of head will tell not only when to wash the filter, but will aid in evaluating water treatment, filter performance and filter troubles.

W&SW

Los Angeles Corrosion Meeting on West Coast Problems

Corrosion problems of the West Coast will be given special attention at the Fourth Annual Western Regional Conference of the National Association of Corrosion Engineers to be held at Los Angeles November 18-19. Topics likely to be especially interesting to NACE members and others from this section of the United States have been scheduled.

On November 19, a symposium on waste disposal will consider topics such as "Corrosion of Steel and Concrete in Sewerage Systems" and "Methods of Controlling Corrosion in Sewerage Systems." During the afternoon, the Steel Water Line Corrosion Symposium will hear papers on the topics "Manufacture of Pipe Coatings, Coal Tar Enamel Protective Coatings, Concrete-Mortar Coatings, Application Methods Used in Coating Pipe Lines, Mastic Coatings and Their Properties" and "Experiences in Water Supply in Los Angeles City."

The meeting follows the 3-day University of California in Los Angeles short course on protective coatings to be held November 15-17 inclusive.

W&SW

F. S. & I. W. A. Convention in Cincinnati

Federation's 27th Annual Meeting Emphasizes Progress in Correcting Sewage and Industrial Waste Pollution of the Ohio River, Hears Reports on Research Projects, and Reviews Plant Operators' Problems.

PROGRESS in cleaning up the Ohio River was emphasized in the program of the Federation of Sewage and Industrial Wastes Association at its 27th Annual Convention, October 11-14, in Cincinnati, Ohio. Registration totaled more than 1,100 members and guests, making this the second largest meeting of the Federation. In 1955, the Federation will hold its 28th Convention at Atlantic City, N. J.

The Cincinnati Convention offered an outstanding variety of technical sessions and inspection trips for representatives of municipalities and industries who came to learn the latest developments in stream pollution abatement. The 35 exhibitors of water and sewage works equipment filled all available display space with the most recent materials and equipment designed for this field.

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Incoming Exec. Secy.
Dr. R. E. Fuhrman

Treasurer
W. W. DeBerard

New Officers

The Federation elected the following officers to serve for the coming year:

President—David B. Lee, Dir. Bur. of San. Eng., State Board of Health, Tallahassee, Fla.

Vice-President—George E. Martin, Ch. Engr., Green Bay Metro. Sewerage Dist., Green Bay, Wisc.

Exec.-Sec.—Editor—Dr. Ralph E. Fuhrman will take over the position to be vacated by W. H. Wisely in January 1955.

Treasurer—W. W. DeBerard, Deputy Commr. of Water, Dept. of Public Works, Chicago, Ill.

Advisory Editor—F. W. Mohlman, Chief Chemist San. Dist. of Chicago, Ill.

Technical Sessions

The program included eight busy technical sessions of which two were held concurrently. The concurrent sessions were an operators' forum and an industrial waste forum. Three excellent motion pictures were included in the program.

The forum sessions are reviewed briefly in this report, and our "technical digests" will summarize a number of the outstanding technical papers in this and succeeding issues.

The motion pictures presented included the premiere showing of "Clean Waters", the 1954 edition of General Electric's motion picture, and a film on "Sewer Maintenance Practice in Mexico City". A film presented by R. G. Tyler, Prof. of San. Eng., Univ. of Washington, Seattle, Wash., titled "Diffusion of Effluents Discharged to Puget Sound", illustrated by model studies the topic of his investigation.

Plant Inspections

One afternoon of the meeting was devoted to scheduled inspection trips to Cincinnati's new Little Miami Sewage Treatment Plant, and to the Robert A. Taft Sanitary Engineering Center of the U.S.P.H.S.

The local arrangements committee also offered trips to many local industrial waste treatment plants in the metropolitan area. These included three meat packing plants, one paperboard plant, three chemical manufacturing plants, two animal and vegetable oil plants, two ceramic plants, one foundry, two breweries, and one metal treating plant.

Members were also given the opportunity of visiting Cincinnati's Mill Creek Sewage Works where twelve 110-ft. digesters are under construction, the City's Barrier Dam Pumping Station, and Central Incinerator (500 tons per day capacity). The sewage treatment plant of the San. Dist. No. 1 of Northern Kentucky was open for inspection of its primary treatment, filtration and raw sludge burning facilities.

The Kettering Laboratories of the University of Cincinnati, where applied research on public health is conducted, were open for visitors.

Social Events

The outstanding social events included Family Night entertainment to start off the meeting, the Federation Luncheon, and the Federation Awards Dinner. At the Federation Luncheon E. J. Cleary was the "pinch-hitter" speaker for the scheduled guest speaker who confused his dates and was unable to be present. Mr. Cleary rose to the occasion very capably and presented an illuminating discussion of his experiences and observations on his recent trip to Europe.

The ladies entertainment was also well planned. It included a Fashion Show and Tea, a visit to the soap plant of Procter and Gamble Company, a trip to the famous Rookwood Pottery and the Eden Parks Plant Conservatory, and participation in the

annual dinner and dance closing the Federation meeting.

Award Winners

At the annual dinner Federation awards and honors were presented to members both in the United States and abroad.

The Charles A. Emerson Medal was presented to Clarence C. Ruchhoft, retired Chief, Physics and Chemistry Section, Robert A. Taft San. Eng. Center, U.S.P.H.S., Cincinnati. Because of illness, Mr. Ruchhoft was unable to attend the presentation, honoring his meritorious service to the profession. The award was telephoned to his home and his wife accepted the award in his behalf.

The Harrison P. Eddy Medal was presented to a group from the University of California for their study of algae involved in sewage treatment by the lagoon method. These were H. B. Gotaas, H. F. Ludwig, W. J. Oswald and Victoria Lynch.

The George B. Gascoigne Medal was presented to Robert D. Bargman, Hyperion Treatment Plant, Los Angeles, Calif., for his contribution to sewage treatment plant operations.

The William D. Hatfield Award was presented to Uhl T. Mann, J. E. Meers and C. W. Christenson for outstanding reports on treatment plant operations in different population classifications.

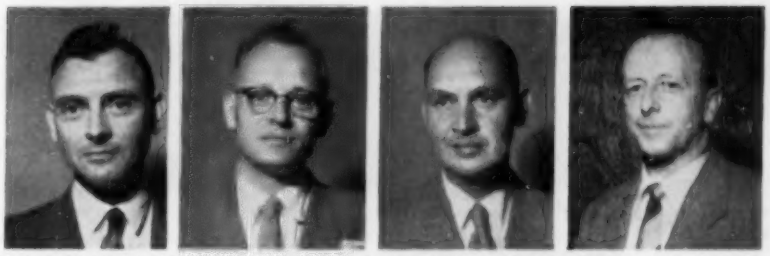
Honorary Membership was presented to Dr. A. E. Berry, Dir. of San. Eng., Ontario Health Department, Canada, and to William T. Lockett, Chief Chemist, Middlesex County, England.

The Industrial Wastes Medal was awarded posthumously to Norris H. Sanborn, formerly of the National Canners Association, for his contributions to the treatment of industrial wastes.

The A. S. Bedell Awards were presented to ten association nominees selected for their service to the local association.

The Past-President's Award was presented to E. Sherman Chase in recognition of his period of service.

A silver tray was presented to W. H. Wisely and Mrs. Wisely by the W.&S.W. Manufacturers Association, in recognition of his outstanding service to the Federation as its Secretary.



VISITORS FROM ABROAD—From England, T. Waldmeyer, Reed & Co., Ltd., London; from Holland, A. Mast and H. H. Verment, Chief Engr., Public Works Dept., The Hague; from Switzerland, Dr. Walter Dardell, Consulting Engr., Aarberg.

Comm. Chairmen

Convention Mgmt.
T. T. Quigley

Program
F. W. Gilcreas
Rolf Eliassen

Award Winners

Emerson Medal
C. C. Ruchhoft

Eddy Medal
H. B. Gotaas

Hatfield Award
Uhl T. Mann

Operators' Forum

The Operators' Forum, C. C. Larson presiding, covered two topics: A report on salary schedules and classifications by T. C. Schaetzle (to be printed later in our "technical digests"), and a review of the technical aspects of biocatalysts in sewage treatment.

The "Biocatalyst" Situation

A panel discussion of technical considerations involved in the application of biocatalysts was first presented and was followed by open discussion from the floor. The forum leader was C. C. Larson, Chemist, Springfield Sanitary District, Springfield, Ill. The panel members were F. W. Gilcreas, New York State Dept. of Health Laboratories; John S. Wiley, Asst. San. Engr., U.S.P.H.S., Savannah, Ga.; Walter A. Sperry, Supt., Sanitary District, Aurora, Ill.; Dr. Ross E. McKinney, Asst. Professor, Mass. Inst. of Tech., Cambridge, Mass.; and Dr. H. Heukelekian, Prof. of Res. Eng., Rutgers Univ., New Brunswick, N. J.

Dr. Heukelekian, in opening the discussion, pointed out that enzymes are the basis of all life—and are essential in the sewage treatment process. The present discussion, however, relates to *artificial* enzymes. Two types of experiments may be made to evaluate their usefulness, the experimental and the theoretical approach.

Experimental work, he noted, has always shown negative value in the application of artificial enzymes. In plant use, the evidence has been considered to indicate certain benefits but conditions have largely been lacking in adequate control. In addition, the artificial enzymes should not be expected to perform the functions of living cells.

Mr. Sperry, in several studies, has found nothing to confirm the claims made for the use of artificial enzymes. Bottle experiments at Aurora and Peoria laboratories, indicated the results of sludge digestion to be the same between control and enzyme-treated sludges.

At Decatur, Dr. Hatfield used a 1,000 lb. sample on plant scale. He reported there was no effect on clogging of aeration plates, no improvement in aeration efficiency, and no improvement in sludge digestion.

Mr. Wiley described a project designed to investigate the application of enzymes to high-rate thermophylic aerobic digestion of compost which included sewage sludge.

W&SW Mfrs. Assn.

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Salaries
T. C. Schaetzle

Dr. McKinney reviewed a survey of literature references and manufacturers' bulletins prepared by McKinney and Sawyer. In 1954 they sent a questionnaire to State Sanitary Engineers, receiving 31 replies to 50 letters. Based on suggestions from the engineers, they queried specific treatment plants and learned that approximately two-thirds considered results negative, and one-third considered results positive when using artificial enzymes. At the present time, none of the commercial biocatalysts have been shown to contain more micro-organisms than are present in an actively digesting sludge.

Mr. Gilcreas emphasized that the basic problem is more specifically that of proper environmental control. Catalytic aids should not be necessary, as sewage has within itself all the bacteria necessary to propogate the enzymes required in sludge digestion.

Open Discussion

Rebuttal to the panel was provided by a number of discussors, all of whom were given their opportunity to be heard.

George A. Jeffreys, Salem, Va., a research biologist, reviewed the field of biological development and pointed to the practical applications of this knowledge.

Dr. Lloyd R. Setter, San. Eng. Center, U.S.P.H.S., Cincinnati, disagreed with any recommendation that digested sludge was needed, or useful, in starting operation of a sludge digester.

Robert Bear, manufacturer's representative, reported many beneficial results from the use of enzyme products (as mentioned in *Readers' Digest* of October 1954).

A. J. Krell, Dir., Reliance Chemical Corp., Houston, Tex., reported on plant scale studies of a biocatalyst which had shown encouraging and practical results.

A. C. Bryan, Pub. Wks. Dept., Houston, Tex., mentioned that experiments with one biocatalyst, applied to an odorous lagoon, had shown satisfactory results. In another experiment, an over-loaded digester responded to the application of this material.

Glen O. Fortney, State Dept. of Health, Charleston, W. Va., reviewed tests which had been made of one biocatalyst as applied to septic tanks. Out of eight treated tanks, only two appeared to be benefitted by the treatment.

Industrial Wastes Forum

Presiding, K. S. Watson, Coordinator of Waste Treatment, Manufacturing Facilities Department, General Electric Realty Corp., Schenectady, N. Y.

Phase I of the 1954 Industrial Wastes Forum considered industrial waste sections of municipal ordinances.

Municipal Ordinances

Fenton H. Dobb, Senior Engineer, City of Cincinnati, Ohio, spoke as a representative of a municipality. Contributors of industrial wastes to municipal sewers, he emphasized, should be governed by regulations which assure equitable treatment to all parties. Industry should be advised of what will be required in volume and concentration of wastes discharged to the public sewer system. Charges, if any, must be levied on an equitable basis. Controls and limitations imposed by municipal legislation should enable industry to plan ahead. Industry should know in advance of changes to be made in sewer lines and in the treatment plant.

A. J. Steffen, Sanitary Engineer, Wilson and Co., Chicago, Ill., presented views of industry which he believed should be considered in municipal ordinances. Waste treatment is viewed by management as a function of production. As such, it is taken into account in new plant construction, in process alterations, and in plant expansion.

If industry is to be treated fairly, municipal ordinances governing wastes should be planned to answer the following questions:

1. Are wastes which reach the public sewers a safety hazard?
2. Is the public health affected, and can any danger be corrected by adequate waste treatment?
3. What are the costs to a sewage authority for handling the wastes, with regard to corrosion and increased labor costs?
4. What will be the cost to industry to comply with proposed legislation?
5. How much waste can be tolerated at the municipal treatment plant?
6. Are charges reasonable in terms of volume of wastes?

Introduction of noxious compounds into public sewers should be entirely prohibited. There should be no prescribing of limits in connection with such materials. Ordinances should require pre-treatment of wastes where temperature, solids, grease or other

characteristic will interfere with operation of the municipal treatment plant. A committee composed of industrial and municipal representatives should consider factors involved in industrial wastes treatment.

Discussions from the floor indicated that control of industrial wastes discharged to public sewers could be maintained by a municipal sampling program. Data on wastes could also be obtained for checking purposes from industries concerned. This problem becomes complex in larger communities with diversified industries. It was pointed out that the burden of proof lies with the municipality. The total concentration of wastes in the public sewer is more important than concentrations in the sewer of wastes from a specific industry.

FAMILY NIGHT—"South Seas Safari" presented by staff of San. Eng. Div., Illinois Health Dept. (1) The Sanitary Engineer and Bloody Mary's Daughter; (2) Charley, a nurse; (3) The "Brass" comes to Bored Bored Island; (4) Finale.

INSPECTION TRIPS—(1) Mobile unit used by City of Cincinnati to measure flow and sample industrial wastes. (2) The New Little Miami Sewage Treatment Plant. (3) At U.S.P.H.S. San Eng. Center, dissolved oxygen meter under development.

OPERATORS' FORUM—(1) Panel members (seated), Gilcreas, Wiley, Larson, Sperry, McKinney, and Heukelekian discussed biocatalysts. (2) Safety Demonstrations—LeRoy W. VanKleeck, Conn. Health Dept. (right), assisted by M. L. Moll, Mine Safety Co.

Industrial Effluent Specifications

Phase II of the Industrial Wastes Forum was concerned with specifications which should apply to industrial effluents.

Frank Milligan, Pennsylvania Department of Health, presented state health department views stating that physical limitations of the municipal treatment plant will prescribe controls over the total volume and types of wastes to be received. Specific exclusions should be made for flammable, toxic and heavy materials.

Fred Olds, Sanitary Engineer, Proctor and Gamble Co., Ivorydale, Ohio, presented ideas from industry. The fundamental object is to get wastes treated with lowest cost to the municipality. New industries must be attracted if a community is to grow and prosper. A city should determine the size and type of treatment plant, together with future expansion requirements, and then provide revenue to operate the plant. Regulations should be established which will protect the sewers and plant from injury.

Limitations as to the permissible B.O.D. and suspended solids content of a waste should apply only once; for example, either at the point where wastes enter public sewers, or at the treatment plant. Rigid specifications can harm a small industrial plant whose waste volume may be small, but of high strength.

In discussion it was pointed out that sewer sizes have a marked effect on charge assessment. Large sewers provide dilution of wastes, while small sewers lack this important factor. Problems of future industrial expansion could be solved by a committee which would evaluate the effect of new wastes reaching the municipal plant, and surcharges could be levied to cover such increases. Procedures for evaluating the effect of industrial waste loading on the city's plant should include composite sampling only during periods of actual industrial operation. Wastes which damage sewer and plant structures should be prohibited from entering the system.

Waste Pretreatment Considerations

Phase III of the Industrial Wastes Forum considered both sides of the question as to whether industrial wastes should go directly to public sewers or be subjected to pretreatment.

N. E. Damron, Sanitary Engineer, Lederle Laboratories, Pearl River, N. Y., spoke in favor of discharge to public sewers, because municipalities are often better equipped to deal with stream control authorities. A community can raise capital funds through available resources or bonding programs and eliminate duplication of waste treatment facilities. Treatment at the city level will ordinarily meet the needs of the community, satisfy stream control requirements and avoid unpleasant relations caused by spills or loss of control at an industrial waste treatment plant.

Harry McElhaney, Talon Co., Meadville, Pa., favored direct discharge of treated industrial wastes to streams, the ultimate destination of wastes—whether direct or indirect. Industry can maintain controlled discharge or dilution of its troublesome wastes, or provide partial to complete treatment if necessary. In discharging direct to a stream, industry must meet only one set of standards, while municipal ordinances are subject to change. Furthermore, pretreatment may be required to add wastes to a city sewer system, when only a slight additional treatment may be required to render the effluent suitable for local stream conditions. Charges and fees will be avoided and city residents will not have occasion to complain about paying the cost of treating industry's wastes.

W&SW

Solving Community Sewage Disposal by High-Rate Leaching System

by HARVEY F. LUDWIG, *U. S. Public Health Service, Washington, D. C.*
and RUSSELL G. LUDWIG, *Consulting Engineer, Alhambra, Calif.*

IN THE High Sierras of California the community of Leevining is typical of the recreational communities located throughout this mountain area. The permanent year-around population is only about 200, but in the summer hunting and fishing season there is a great influx of recreation-seeking visitors, mostly from Southern California. In its effect on problems of sewage collection and disposal, it is estimated that during the peak month of summer activity the population equivalent of the transient visitors is approximately 800 persons.

In 1949 the town had no public sewerage system, but depended upon septic tanks serving the individual building units.

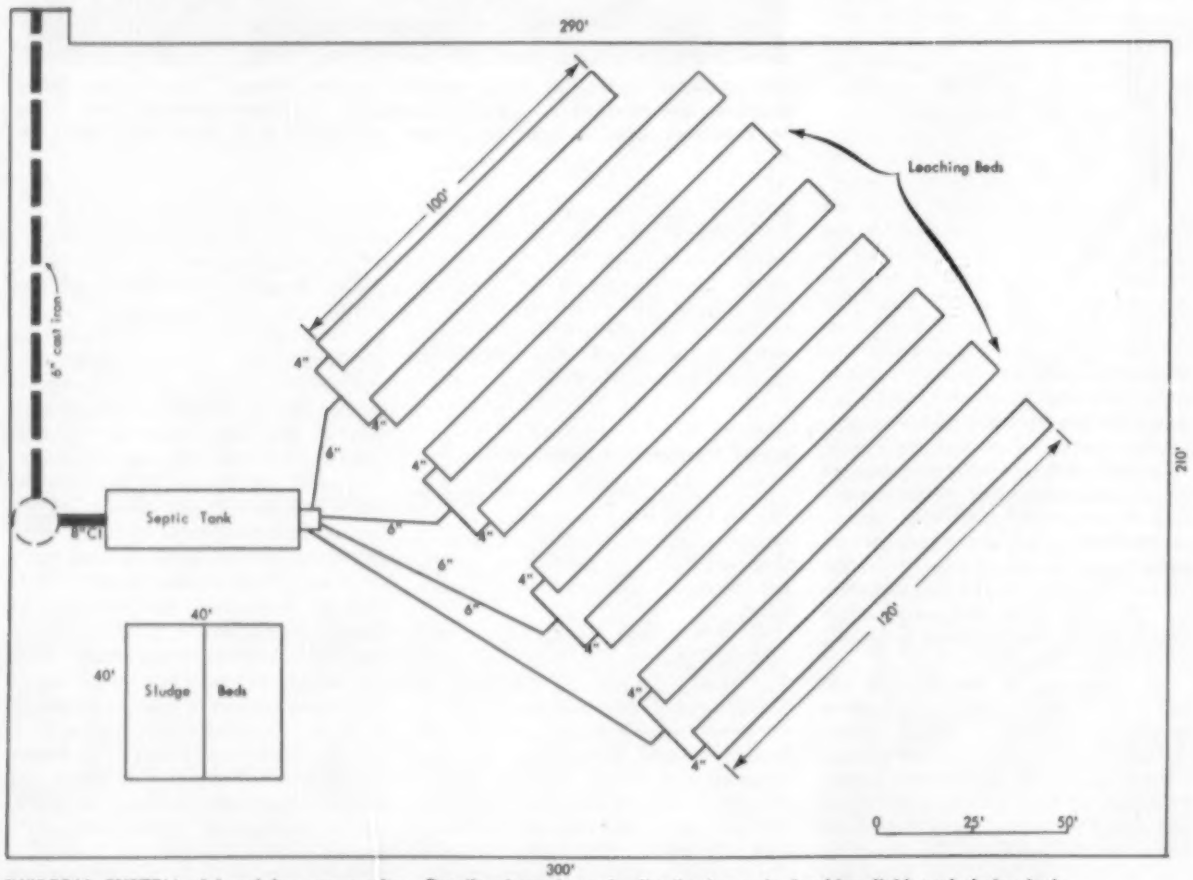
In undertaking a preliminary survey of the disposal problem in 1949, field observations indicated an unusual ground condition. Much of the area of the community and its environs literally stands on top of a vast agglomeration of aggregate, covered by only a few feet of surface soils. There are aggregate pits in the locality, from which the excavated aggregate is of sufficiently good and graded quality to mix with cement to make concrete. Technically this subsurface "soil" might be classified as "unconsolidated sand containing many rock fragments." Ground water is at great depth. This combination of conditions seemed practically the "textbook ideal" for a septic tank-underground leaching type of disposal system.

Choice of Disposal System

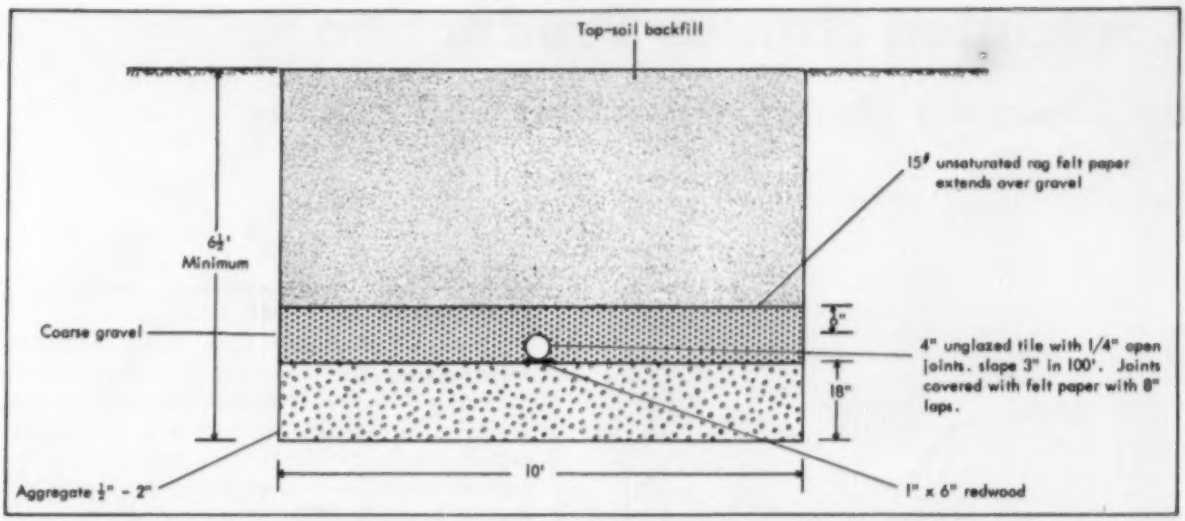
By means of subsurface borings made with a two-inch auger, a site for a suitable leaching area was located and subjected to percolation tests[1] to determine its capacity to leach away septic tank effluent. The equilibrium leaching rate for septic tank effluent, at depths from 6 to 10 feet, was computed to be 30 gallons per square foot per day. This is about ten times the rate for most soils.

Some difficulty was experienced in "selling" the proposed design to the public health authorities concerned, presumably because of the unconven-

1. "Improved Soil Percolation Test for Design of Sewage of Effluent Leaching Fields." *Water & Sewage Works*, May, 1949.



DISPOSAL SYSTEM of Leevining community—Details of septic tank, distributing weir, leaching field, and sludge beds.


Top-soil backfill
15# unsaturated rag felt paper extends over gravel
6½' Minimum
Coarse gravel
4" unglazed tile with 1/4" open joints, slope 3" in 100'. Joints covered with felt paper with 8" laps.
18"
10'
Aggregate ½" - 2"
1" x 6" redwood

LEACHING TRENCHES—Typical cross section for the eight trenches, ranging in length from 100 to 120 feet.

tionally large size of the leaching system.

Design Features

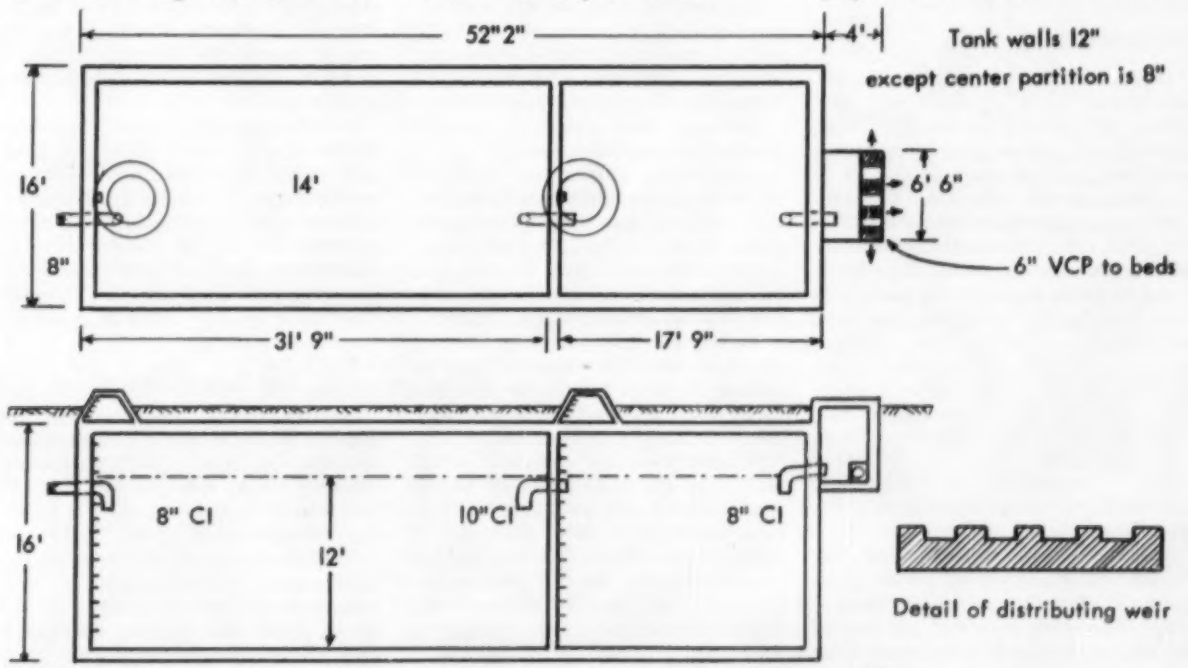
The sewage collecting system comprises approximately 6,000 feet of vitrified clay pipe, mostly of 8-inch diameter, installed at depths from 4 to 8 feet, and 31 standard manhole structures built of reinforced concrete. The sewer pipe joints were made with cement mortar.

The disposal works consists of a reinforced concrete septic tank of 64,000 gallons capacity, a 6-inch cast-iron influent line to the tank, an effluent distributing box, and 8 leaching trenches each 10 feet wide and from 100 to 120 feet long providing 9,400 square feet of leaching area. The accompanying drawings show the details. The final design leaching rate is 6.4 gallons per square foot per day (based on the estimated sewage flow of 60,000 gallons per day), or less than one-fourth the test rate. The large factor of safety was allowed to circumvent any hazard of clogging.

Construction of the system was completed in July, 1950, at a total contract cost of $37,300. This includes a sum of $19,100 for the collecting sewers and $18,200 for the treatment and disposal works.

Operating Experiences

On completion of the project the engineer recommended a schedule for maintenance, requiring the part-time services of one employee. His duties would include sewer cleaning and maintenance, and periodic inspection of the sludge level in the septic tank to ascertain when sludge pumping is necessary. However, as is the case with most "ideal" solutions, even this simple maintenance routine has not yet been met. Functioning satisfactorily for the past four years, and completely out of sight, the town governing board considers their sewage problem "solved."



SEPTIC TANK—Plan and side elevation of the reinforced concrete septic tank, 64,000 gal. capacity.

Controlled Humus Production

by Separate Sludge Digestion and Drying

Part 2—The Plant and Structures

by LEONARD L. LANGFORD

Mr. Langford is Eastern Sales Manager, Pacific Flush Tank Co., Port Chester, N. Y. In three comprehensive articles, he evaluates the digestion and drying of sewage sludge in terms of a manufacturing process. His paper was presented at the seventh annual meeting of the Virginia Industrial Wastes & Sewage Works Assn.

THE site of the sewage treatment works, as of most factories, is largely determined by the availability of the raw material, cost of land, and adequacy of suitable disposal facilities for the finished product. Power generally can be brought to any location meeting these very general stipulations.

Unlike most manufacturing plants, however, whose structures and equipment normally meet minimum productivity standards and safety regulations, the process of liquid humus production in many cases bears little relationship to recognized efficiency and health standards. The design of digestion tanks and their operating structures frequently appears to be determined by political as well as pseudo-economic considerations. While plans and specifications usually are adequate, builders often are picked on the basis of lowest initial cost, rather than on experience and knowledge of the peculiarities of the structures and machinery required. This policy results in the construction of units of different shapes and proportions, and a multiplicity of combinations of process machinery.

Incomplete Sewage Works

When turned over to the owner, the works are not necessarily complete. All parts, machinery, tools, worksheets, space parts, operating schedules and instructions may not be in place—or even available. Unfortunately, months sometimes elapse before the superintendent can convince the board of directors that funds must be made available for tools, piping, hose, lights, laboratory apparatus and supplies, paint, grease, cleaning utensils, workbench, lawnmower, and a truck or other automotive conveyance which he lacks. Likewise ladders, rope, safety harness, fire extinguishers and other items of industrial safety equipment, the immediate availability of which might save a life, may be needed.

This is a dark picture, but one which unfortunately is not exaggerated. Within my own experience I have been made aware of the hazard of lack of oxygen in a basement room where two men were overcome by gas because of leaking tank structures. At another plant, leaking of sludge liquor into gas piping within a digester rendered useless the entire gas utilization system for many weeks.

Many readers are familiar with inadequately insulated structures, requiring an excessive and costly expenditure of fuel in order to maintain suitable process temperatures within digesters. At another plant which comes to mind, leakage at one fitting in the gas piping system could have been the cause of serious structural damage, had it not been for the presence of mind of a night watchman making his rounds. These instances occurred in newly constructed plants.

Regular, in other words *periodic*, inspection of all parts of structures and machinery will increase efficiency of production, and may forestall a serious accident or prevent a fatality.

Reconstruction of any part of structures or of machinery and piping, the original design or construction of which in practice proves to be hazardous or inadequate, should be undertaken as soon as possible. Fatal accidents have been caused, for example, by the unsafe installation of step-irons or dangerously-angled stairs.

Unserviced machinery results in a shutdown of some duration, with resultant loss of process efficiency. Equipment inaccessible for safe servicing can always be relocated.

Where process efficiency is impaired by the installation of pumps inadequate in terms of capacity, head characteristics, location, or method of piping connections, the management should make suitable changes promptly. We have all observed piping installations where the addition or relocation of one or more valves would enhance operating efficiency several-fold.

How to Save Man-Hours

The addition of vacuum and pressure gauges on sludge piping, for example, or additional gauges at a more central location, could mean the saving of fifteen man-days a year, not to mention seven hundred to one thousand possible trips up and down stairs. An ammeter placed in a pump motor circuit gives an instant picture of the work being performed—or tells immediately which of several pumping units is in operation.

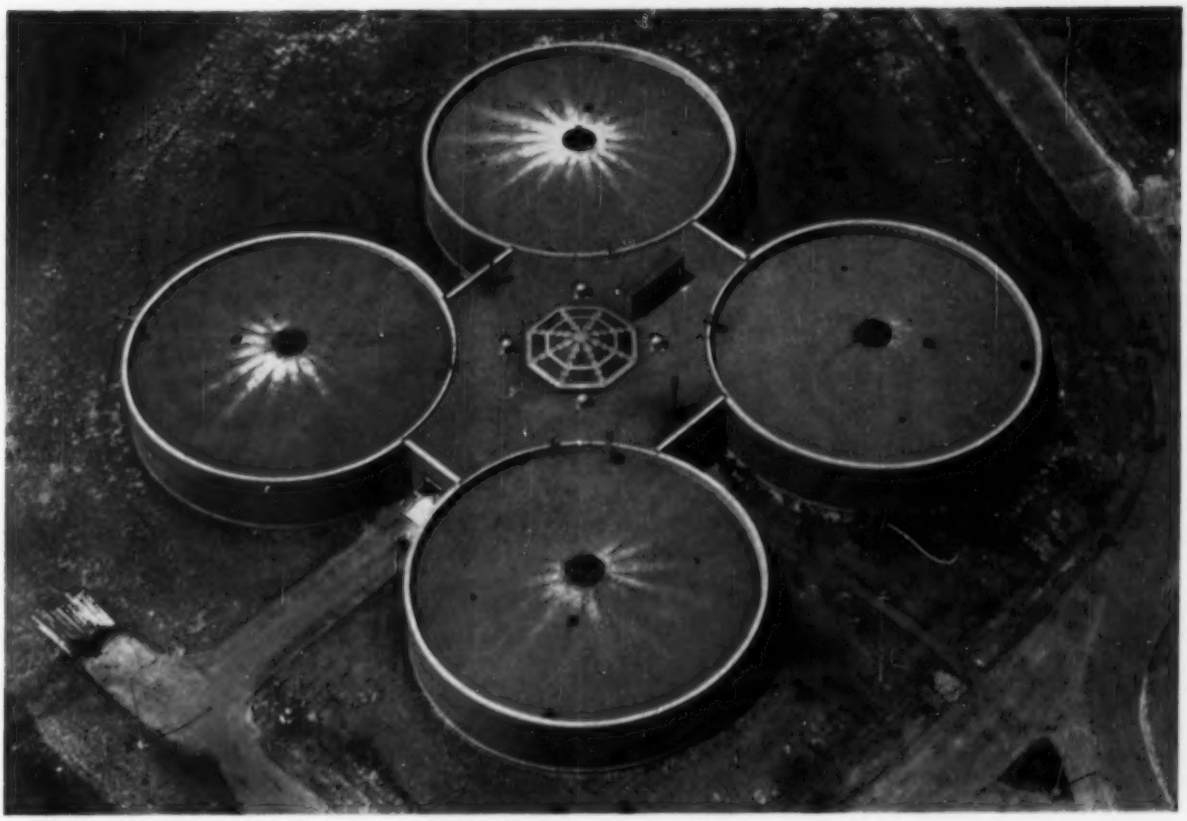
Additional points of back-flushing connections of proper size and style can save hours in a year's time. Replacing an elbow with a tee and blank flange is frequently a boon to an operator, where the original designer failed to visualize what might happen at such a point.

Modified repiping within a digester, or the installation of additional pipe and fittings to provide better control of the process, can be accomplished whenever an operating unit has to be emptied and entered. Where there is inadequate means of grit removal, a percentage of this portion of the raw material frequently must be removed from the digester.

The Raw Materials

As they affect the efficiency of process reaction, some consideration should be given here to the characteristics of those raw materials which will feed the crucible of the wet burning process—the digester.

This raw material may be primary, intermediate, waste-activated, or secondary sludge; or a mixture of any or all of them. Its variation in quality and quantity on an hourly, daily, and seasonal basis demands the utmost



PLANT and structures for controlled humus production — digesters at the Bergen County Authority (N.J.) works

flexibility in plant and process facilities, together with conscientious adaptability of supervisory personnel.

It is imperative that the plant be provided with adequate "means" in terms of pumps, piping, concentration tanks, hose, supplemental beds or lagoons, if there is any possibility of the treatment plant's receiving undesirable wastes. Not all raw material received is "grist to our mill." One of the most difficult problems frequently confronting management is that of separating those constituents in the raw sludge which will interfere with either the mechanical or the biological aspects of process operation.

Undesirable Constituents

As a case in point, a certian Pennsylvania sewage works occasionally receives as much as three thousand gallons of spent machine oil-sludge emulsion. Not only does the oil interfere with the process of sludge digestion, but it renders difficult the handling of sludge in the sedimentation tanks, because of its reduced specific gravity. Fortunately, this treatment plant is provided with preaeration and sludge receiving tanks, where emergency measures can be taken, and by dint of extra time and labor, a fair degree of separation can be achieved.

At another time, raw sludge included a concentration of naphtha and benzine, to the extent of registering better than 110 on an explosimeter scale. Pumping of such material represented a particular safety hazard, and emergency elutriation was used without delay.

With regard to industrial wastes, Besselievre[15] comments as follows: "The solids removed from industrial wastes can, in many cases, be handled in a manner similar to municipal sewage sludge. If the solids are of an organic nature, which will normally decompose, the digestion process is suitable. The process may be used in its normal place as a means of disposing of the wet sludge removed from sedimentation basins, provided it has not been chemically treated to such a degree as to inhibit or destroy the required bacterial action.

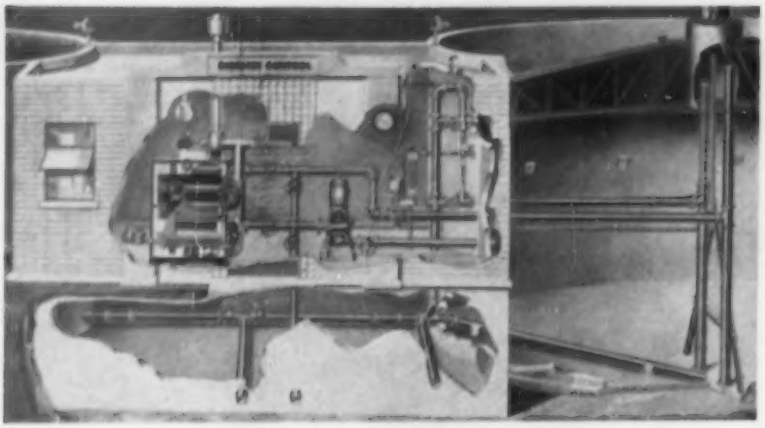
Successful digestion of some industrial wastes demands very close control of temperature during digestion, to within one-half degree of the determined optimum.

Effects of Trade Wastes

Where it is suspected or known that one or more industrial waste is reaching the works, the following check list[16] can be used to determine the characteristics of such waste:

1. Volume variation—daily, hourly, or seasonally
2. Chemical composition—biological, mineral, organic
3. Physical composition—color, oil, sediment, temperature, etc.

Deleterious effects of trade wastes upon sludge digestion are confined largely to interference with the biological process involved. Wastes may result in difficulty in establishing or maintaining normal digestion. In reporting on the effects of penicillin wastes, Mann[17] observed that ". . . it was not the nature of the wastes which interefered with operation, but the quantities." In the cases of two of the larger cities in Connecticut, separate sludge digestion had to be abandoned, in one case after contracts had been let for structures and equipment, and in the other case, after plans and specifications had been completed and officially approved. Here the increased concentrations of copper, following



PHANTOM view—Controls for a "Controlled Digestion" system

World War II industrial activity, indicated that a serious toxic condition might very possibly result in difficulty with digestion.

Wastes with high inorganic solids content, which are taken in or otherwise find their way into municipal sewage treatment works, can easily cause unnecessary and troublesome deposits in digestion units, thus reducing the available volume of such tanks for the receiving and digestion of organic matter. Wastes having a high percentage of volatile solids may cause an unexpected increase in gas production for which adequate facilities were not originally provided, thus reducing process efficiency.

Processing the Materials

Separation of the sludge particles in the sedimentation tanks and their transfer to the digester should not be a mere routine operation—left to the whim of the moment. Even those particles which are settleable will not remain settled indefinitely. Always remember that they are undergoing, at very least, a tendency toward reduction (decomposition) while still in the sedimentation unit. The extent to which this condition may progress depends upon several factors.

(a) the type, extent and condition of the sewer system
(b) the rate of sewage flow
(c) the extent to which the particles have been comminuted
(d) the temperature of the waste
(e) the age of the sewage
(f) the specific gravity or the particles which in the aggregate become "separate sludge"

It can be stated that the more closely the *rate* of transfer of raw sludge to the digester agrees with the rate of settling in the clarifier, the more efficient will be the operation of *both* units. This implies as nearly continuous transfer as is practicable. Fortunate are the works provided with sludge hoppers, and piping and pumping facilities which will permit of time-clock operation of primary sludge transfer, supplemented with complete purging of sludge hopper accumulations at prescribed periods such as the beginning of each shift.

Sludge Transfer Facilities

This leads to a consideration of the means of making raw sludge transfer —usually a sludge pump of the displacement or centrifugal type. Operators should make certain that they are fully familiar with their equipment. Manufacturers' data on such units should be in the file at the plant —not uptown. It is important to know pump capacity and head characteristics as well as details of operation and maintenance. With adequate use of suitable plunger packing, or proper type of stuffing box seal, well-designed pumps *need not* present a dirty appearance. They *can* be kept clean; and if these units are found to be properly attended, other machinery usually will be well serviced.

It is important to post in a suitable place a detailed and complete piping diagram of the entire plant. This preferably should show the relative type and location of all valves, numbered to correspond with numbers attached to the actual valves.

If the sludge pumps are located below grade, make very certain that there is adequate ventilation in the room or chamber in which they are located, bearing in mind that lack of oxygen has been the prime cause of death at sewage works. Ventilation must be sufficient in *all* rooms and chambers, when all doors and windows are tightly shut! Plant personnel should be acquainted with the Manual of Practice No. 1.[18]

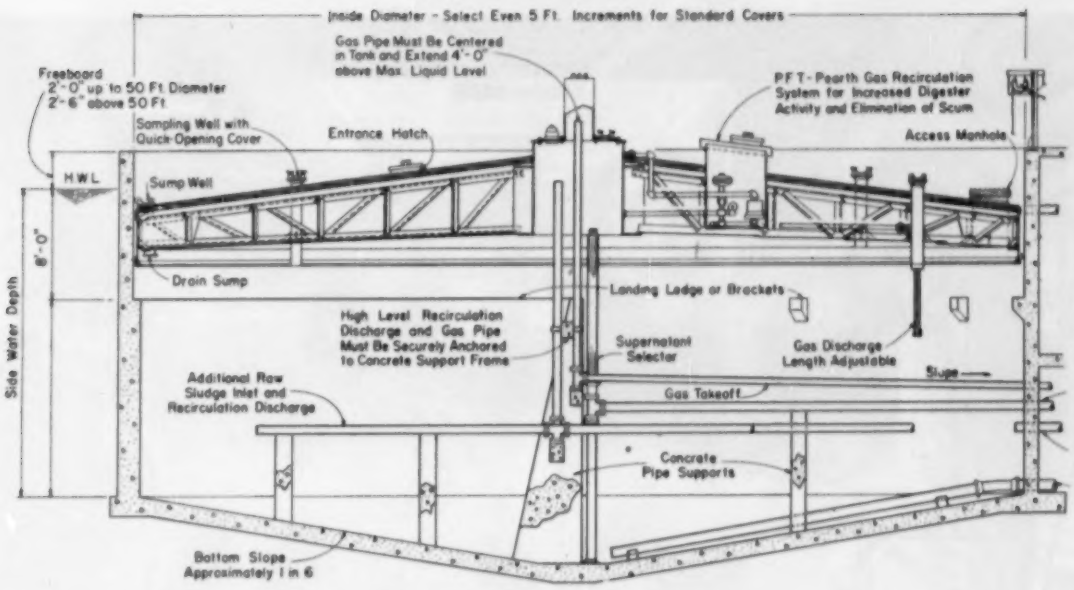
The transfer of sludge from sedimentation units cannot be accomplished properly without having a visual knowledge of the characteristics of the transferred material. This requires the provision of suitable means of sampling, preferably convenient to the sludge pumps. Pumping material having as great a specific gravity as possible, reduces the heating requirements both for raw sludge input, and for the radiation losses of the digesters. If, by attention to sampling during raw sludge pumping, material of 5 per cent rather than 3 per cent solids can be discharged to the digesters, a saving of 1,300,000 pounds of wet sludge can be effected for every 100,000 pounds of dry solids handled.

The transfer of raw solids in a condition as fresh as possible is of the greatest importance. Such action will "automatically increase plant and process efficiency and reduce costs," according to Hood[19], who further points out that, "When the pH-alkalinity value of a sewage compares closely to that of the water supply (of which it is constituted) then the sewage is necessarily in a 'fresh" condition."

We should by now have determined the point at which the raw sludge (as well as recirculated material) is to be discharged into the digester, assuming that there has been a choice provided. Raw sludge, preferably preheated and inoculated, should be discharged at a point which will: (a) allow for sand and grit to be deposited (gravitationally) close to the point of discharge of the digested sludge, and (b) allow for mixing with the contents of the digester at or above the sludge line and adjacent to the gas dome area.

The maintenance of liquid material of optimum temperature and containing great numbers of virile organisms of suitable types, within the general area of the base of the gas dome, will go far toward insuring against top sludge (scum) accumulations. A scum blanket is undesirable as it results in reduction of temperature, reduction of moisture, impedance of gas flow, and loss of tank capacity for digestion.

We are interested also in reducing the volume of supernatant liquor which must be withdrawn from the digesters. Supernatant liquor is of the utmost importance, because of the space it requires in the digesters, as well as its effect upon the material with which it is mixed upon its discharge. Its quantity and quality are matters of concern to a conscientious operator; beneficial use can be made of it in secondary treatment of the activated sludge or trickling filter type.[20]


Inside Diameter - Select Even 5 Ft. Increments for Standard Covers
Gas Pipe Must Be Centered in Tank and Extend 4'-0" above Max. Liquid Level
Freeboard 2'-0" up to 50 Ft. Diameter 2'-6" above 50 Ft.
Sampling Well with Quick-Opening Cover
Entrance Hatch
PFT - Fourth Gas Recirculation System for Increased Digester Activity and Elimination of Scum
Access Manhole
H.W.L.
Sump Well
8'-0"
Side Water Depth
Drain Sump
Landing Ledge or Brackets
High Level Recirculation Discharge and Gas Pipe Must Be Securely Anchored to Concrete Support Frame
Supernatant Selector
Gas Discharge Length Adjustable
Slope
Additional Raw Sludge Inlet and Recirculation Discharge
Gas Takeoff
Concrete Pipe Supports
Bottom Slope Approximately 1 in 6

DETAILS of a floating cover digester, interior piping, and gas recirculation system

The volume of sludge pumped can be determined by a suitable sludge position indicator. The indicator device should be equipped with both high and low sludge level alarms for efficient and safe operation. Volumes of raw sludge input and sludge liquor withdrawn should be noted on the daily operation log.

Agitation of Digester Contents

That portion of a digester in which primary digestion is taking place might properly be thought of as an ebulliate cauldron in continuous ferment. Such a condition must exist, if adequate numbers of microorganisms of the desired types are to survive and multiply in the liquid environment. Intermixing and synthesizing of the tank contents aids in exposing the particles of organic matter to the biological population continuously requiring food in quantities out of all proportion to its size.

The optimum degree of agitation depends to some extent upon the rate of digestion at any given period. Under conditions of low solids input of raw material, and improper temperature or reactive conditions, turbulence may amount to only a mild simmer.

For best digestion results, a boiling rather than a simmering condition should prevail. To achieve this, it is necessary to increase the specific gravity of the undesirable vultex, lignin and keratin materials, of which primary clarifier skimmings are largely composed. These light substances rise to the surface because they become saturated with gas particles.

Some ebullition will be achieved through the gas produced as a natural result of the metabolic processes of the organisms. This should be supplemented by: (a) circulation of actively digesting material, raw sludge, and buffer material, in whatever proportions are feasible; and (b) introduction of compressed sludge gas at multiple points within the sludge liquor zone.

The lifting action of the gas against a top sludge blanket is violently effective, and can be employed economically.

Controlled degradation of the organic material by an orderly vertical progression of reduced volatile solids, is of the utmost importance. Otherwise, a percentage of the final product will be composed of raw or semi-digested solids. Every digester should be operated to obtain a well-digested material from the bottom of any primary tank or final tank in a stage system! Bottom material must not be deliberately agitated during or immediately prior to transfer to succeeding process units.

To maintain a high degree of process efficiency, it is imperative to inoculate both raw feed and material which indicates a retarded digestion rate. The introduction into a primary digester of a preheated mixture of raw feed and low volatile acid secondary tank material—or recirculated primary tank sludge—can often be regularly practiced to advantage. Recirculation from the bottom of an active primary unit for a short time following each raw solids loading is another inoculating procedure which has been used successfully by many plant managers.

Temperature plays a very important role in the rate of volatile solids digestion. To be most effective, the temperature must be uniform throughout the entire depth of the digestion tank, and should be maintained a few degrees above or below an established optimum value.

A study of the records of digesters where excessive top sludge accumulations have been encountered reveals that the temperature in the scum zone were considerably lower than those maintained in the body of the sludge. The methane-producing organisms are quite sensitive to temperature changes, and cannot tolerate rapid variations in temperature without a marked decrease in activity.

External Heating of Sludge

Realization of these facts led about eight years ago to the development by H. E. Schlenz[21] of the first practical external sludge heater. As pointed out in a paper entitled, "What You Should Know About Sludge Digestion," the external heater and heat exchanger unit makes possible the automatic maintenance of an optimum and uniform temperature within one degree Fahrenheit. With the use of this popular method of sludge

INTERIOR of the modern sludge digestion control building, Levittown, Pa., treatment plant

heating, digester contents are recirculated through tubes in the heat exchanger portion of the unit. When raw sludge is to be added to the digester, it is first mixed thoroughly with active recirculated sludge-liquor and pumped through the sludge tubes for heating to proper temperature before being discharged into the tank. Thus great variations in tank temperature due to raw sludge additions are avoided. The entire heating system is controlled by a sensitive thermostatic bulb located at the inlet to the sludge tubes, and is dependent upon the temperature of the recirculated digester contents.

Recording of the temperature of each digester by means of a seven-day chart instrument, actuated by a sensitive bulb placed at a suitable point in the gas piping system, will avoid erroneous temperature indication, such as may result when the bulb is located within the more protected reaches of the mass. This chart may, incidentally, also indicate the exact times and extent of raw sludge input.

Too frequently, provision is lacking for means of conveniently adding such suitable chemicals as may be required to correct any nutritive inbalance which may exist in the raw sludge. Sewage and trade wastes are frequently deficient in one or more of the minerals essential to the maximum rate of bacterial metabolism. A low pressure automatic and proportional chemical feed pump, or similar device, can be utilized also to add calcium compounds for neutralizing an acid condition. Lime for example must be used with discretion, however, as an excess might easily result in a retardation of the activities of those organisms responsible for the complete decomposition of some of the intermediate products of digestion. The use of calcium phosphate or sodium nitrate might well prove beneficial for the purpose of reaction control.

How to Start a Digester

All too frequently, sludge is allowed to accumulate in a clarifier and, without any thought whatever, is pumped into the digester every day or two, or three. Shortly the digester becomes full of liquid, together with sufficient acid sludge to contaminate the entire tank. Months elapse, and everyone concerned wonders why at least sufficient gas is not being produced to supply building heat. This is a sorry picture and, assuming the absence of toxic wastes in the raw sludge, one for which there is little excuse.

The starting of a digester should be carried out with due regard to the safety of personnel and structures, in the following stages:

(a) Fill the digester with fresh, raw sewage as fast as possible, to the minimum point required to evacuate all air within the tank.

(b) Bring this sewage up to about 80° F. by the use of auxiliary fuel, when necessary.

(c) Then, and not until then, transfer fresh, raw pre-heated solids, three of four times a day. If during the time required to establish the starting temperature, the accumulated sludge has deteriorated into the first or acid stage of digestion, continue to hold it separately until a later time.

(d) Maintain continuous control of the temperature in the digester, raising it a degree or so a day, until about 85° F. is attained.

(e) Withdraw supernatant liquor continuously at a controlled rate of from five to fifteen gallons per minute (depending upon the size of the digester), maintaining a safe volume of material in the tank. Do not withdraw during the periods of addition of raw solids, or it will be impossible to determine the amounts withdrawn or introduced.

From twenty to thirty days after the above procedure has been followed, some burnable methane gas may be anticipated, assuming a normal percentage of volatile solids in the raw waste. In transferring material in a two-stage system, care should be taken to prevent depletion of the best-digested solids in the primary units.

Checking Digester Operation

To maintain a close check upon conditions within a digester, volatile acid determinations, together with Oxidation-Reduction potential measurements, offer a control even more sensitive than pH or alkalinity tests. This is particularly true of tanks handling higher than normal loadings; that is, loadings of greater than four pounds of total solids, or three pounds of volatile solids, per cubic foot of digestion capacity per thirty days.

As explained by Schlenz[21], "In practice, if the volatile acids determination indicates a concentration of, say, 2,000 ppm in a sample taken from a digester, or if succeeding determinations indicate a continued rise in the concentration of volatile acids, either of the following steps must be taken: (i) Reduce the loading of raw solids in the digester showing the increase by diverting some of the raw solids to another digester in the system; or (ii) Circulate lower volatile acid content material from a second stage digester to the overloaded primary digester. As a result, a more rapid gasification takes place and the volatile acids are reduced much more than can be accounted for by mere dilution."

Provision must be made for handling of the by-products of sludge-humus manufacture, among which are the liquids known as sludge-liquor and supernatant liquor. Since approximately 95% of the weight of raw sewage consists of liquid, and since still more is produced as a result of the digestion process, it will be realized that such a volume of liquid takes up space in the tank which should be made available for additional raw material. Liquid drawn from an active primary digester may contain a high percentage of solids. It should therefore be referred to as "sludge-liquor," and should be transferred daily, to secondary tanks if available.

Because of the reduced activity within secondary units, liquor drawn therefrom may properly be called "supernatant," and it should be drawn off more or less continuously, at a low rate so controlled as to prevent any detrimental effects on the main treatment processes. Use of a multiple fixed orifice selector device will insure that a relatively low-solids content liquor only will be automatically discharged through a controlled supernatant gauge.

Sludge liquor and supernatant both contain ammonia, which can be made available to the organisms promoting aerobic oxidation, in connection with either the activated sludge process or trickling filters.

References

14. Schlenz, Harry E., "Sludge Digestion: A Discussion Prepared for a Meeting of the North Carolina Sewage Works Association and the North Carolina Section of the A.W.W.A., November 11, 1947," (unpublished paper).

15. Besselievre, Edmund B., *Industrial Waste Treatment*, McGraw-Hill Book Co., New York, 1952, p. 158.

16. *Ibid.*, p. 90.

17. Mann, U. T., "Effects of Pennicillin Wastes in Ley Creek Sewage Treatment Plant, Syracuse, N. Y.," *Sewage and Industrial Wastes*, XXIII:11, November 1951, p. 1457.

18. "Occupational Hazards in the Operation of Sewage Works," Manual of Practice No. 1, Federation of Sewage Works Association, Champaign, Ill., 1944.

19. Hood, John W., "Copper Sulphate for Root and Fungus Control in Sanitary Sewers and Storm Drains," Phelps Dodge Refining Corp., New York, 1949, pp. 11, 16.

20. Kraus, L. S., "The Use of Digested Sludge and Digester Overflow to Control Bulking Activated Sludge," *Sewage Works Journal*, XVII:6, November 1945, 1177-90.

21. Schlenz, Harry E., "What You Should Know About Sludge Digestion," *Public Works*, LXXXII:pp. 67-71, 98 & 100, October 1951.

(Part 2 of three parts)

W&SW

Coleman and Quigley Honored by De Laval For Long and Distinguished Service

TIME FLIES PAST—Veterans Coleman, left, and Quigley, center, are congratulated by James P. Stewart, De Laval President.

Special awards for distinguished service records of exceptional length were presented to Charles E. Coleman and Leslie D. Quigley at a recent dinner held by the De Laval Steam Turbine Company in honor of its veteran employees.

Mr. Coleman has long been associated with municipal water works engineering. He is active in a number of professional organizations, including the American Water Works Assn. and the Pennsylvania Water Works Operators Assn. He is a graduate of Bucknell University, with a degree in Mechanical Engineering.

Mr. Coleman joined De Laval in 1919 and has served successively as Test Engineer, Pump Design Engineer, Sales Engineer of water and sewage works pumps, and Estimating Engineer. His present title is Assistant Chief Engineer of the Pump Department.

Mr. Quigley joined De Laval in 1909 as a blue-print maker. After serving as a draftsman in the Marine Gears Department the Steam Turbine Department, and the Pump and Compressor Department, he was made Assistant Chief Draftsman in the Water and Sewage Works Pumps Department. He is now Supervisor of the Pumps and Compressors Design Department.

Controlling a Sewage Grease Problem

by WILLIAM A. CORDER

Mr. Corder is Superintendent of the new Sewage Treatment Plant, International Airport, Amon Carter Field, Fort Worth, Texas.

THE SEWAGE treatment plant of the International Airport at Amon Carter Field, Fort Worth, Texas, was placed in operation April 18, 1953. The completely new treatment plant was originally designed to use standard trickling filters with intermittent dosing chambers. This dosing arrangement has been modified until there is now continuous filtration.

The capacity of the plant is 500,000 gal. per day. Treatment units include primary settling, standard trickling filters, and final settling units.

To keep the trickling filters operating properly, we are recirculating effluent at the rate of 72,000 gpd. We are using only one filter because our flow is so low that the plant is overdesigned for present needs. Sewage treated has averaged 50,000 gpd.

The influent is an exceptionally heavy domestic sewage. It is received principally from the airport restaurant, sandwich bar, sinks, lavatories and restrooms.

Sewage Characteristics

The following analyses illustrate average characteristics of this sewage:

Settleable solids	= 15.92 ml per liter
Total solids	= 1,640 ppm
Suspended solids	= 633 ppm
Grease	
(first 12 mos.)	= 468 ppm
(next 4 mos)	= 225 ppm
B.O.D. influent	= 373 ppm
B.O.D. effluent	= 17 ppm

Kitchens and food preparation areas were equipped with the most modern equipment for grinding and disposing of wastes to sewers. Soon after the treatment plant was placed in operation, both the sewer lines throughout the collection system and also the sewage treatment units began to clog and coat with grease.

The walls of the primary settling basin became coated with grease ¼-in. to ¾-in. thick, and the walls of the filter bed were coated to a thickness of ½-in. to 1-in. A grayish-white coat of grease started to form on the stone of the filter bed, and we were skimming 30 to 50 gallons of grease daily from the primary influent chamber.

The digester had a 24-in. deep layer of scum on top, and the scum was composed of 30 per cent to 40 per cent grease. The walls of the dosing chamber coated over with grease in one week to a thickness of ¼-in. to ¾-in. We scraped off such a layer each week. This waste was 20 per cent to 25 per cent grease. Grease appeared in the final settling basin as crystal or saponified grease, in lumps ½-in to 1-in. diameter. The distributor arm had to be scraped out often.

During August, 1953, we started the application of Bionetic to determine if this "bacterial catalyst" would be of benefit in control of the grease problem. We added 10 lbs. in two days at several points over the sewage system, and another 10 lbs. was added to the scum well and pumped into the digester. Each two weeks since that time we have added 1.5 lbs. of Bionetic, applying 0.75 lb. in the food waste grinders in the Terminal Bldg., and 0.75 lb. in the digester.

The thick scum covering the top of the digester has been reduced to about 4 in., and we have gas pressure equal to 4.5 in. of water. A green scum was released from the walls of the primary settling basin in slugs from 4 in. to 10 in. diameter, ½in. thick (7 per cent to 10 per cent grease).

During the first two months after the Bionetic was added, large amounts of gas were liberated from sludge in the primary settling tank. The walls of the primary settling tank are free of grease, as are the walls of the dosing chamber.

The walls of the filter bed are free of grease. The stone of the filter bed is covered with a good biological growth, and is as grease-free as can be expected. The sewer lines are clean.

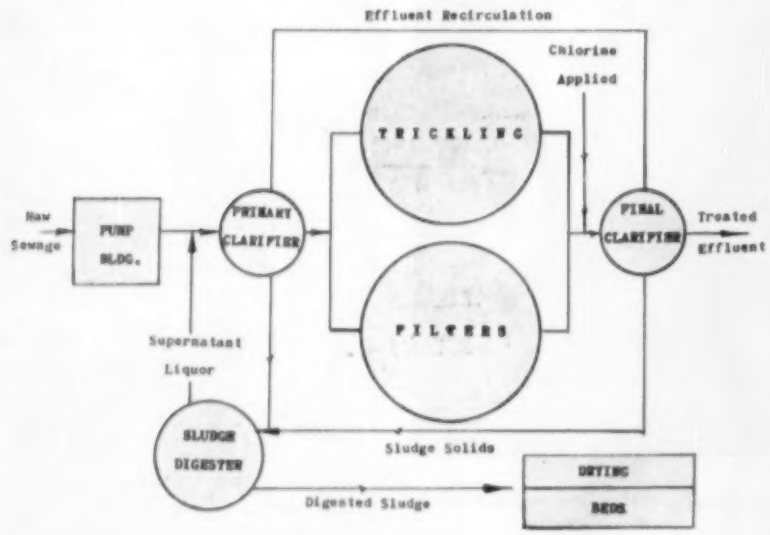
Grease Reduction Accomplished

A substantial reduction in the grease content of the raw sewage has benefitted plant operation.

We explained the seriousness of the grease problem to the employees in the kitchens and dining rooms. We took them on a tour of the sewage treatment plant so that they could see our difficulties first-hand. They were encouraged to save the grease for commercial sale, instead of putting it down the drain. This educational and training program has resulted in a reduction of the grease content of the influent from the original 468 ppm to the present 276 ppm.

The application of Bionetic is still made in the sewer lines and in the digester every two weeks. We consider this treatment to be of continued benefit in keeping the plant clean.

W&SW



SCHEMATIC flow diagram—International Airport sewage treatment plant.

Sanitary Engineering and Industrial Wastes

An Open Letter from One Engineer to Another

Dear Bill.

At the ASCE Meeting in New York, in October, there was a panel discussion of the place of the consulting sanitary engineer in the field of industrial waste treatment. As you know, I'm interested in that subject and I know that you are too since you soon will be entering the field. I couldn't resist putting in my two cents worth and I thought you'd like to hear about it, since we've discussed the situation before.

The panel was presided over by John Kinney, recently of the Ohio River Sanitation Commission and now in the Cons. Engineering field. On the panel there were two consulting sanitary engineers, (one representative of a state control agency one of an equipment manufacturer), and three sanitary engineers employed by process industries.

Some Questions Posed

Several of these questions raised were obviously the result of criticisms that had been made by industry. Others were criticisms by engineers. Among the questions were these:

(1)—Should a state control agency help industry design its waste treatment facilities?

(2)—Should an equipment manufacturer help industry design treatment facilities?

(3)—Should pollution control agencies set effluent standards or base abatement requirements on stream standards?

(4)—Should a consultant give an industry an estimated cost of pollution abatement facilities before making a survey of the situation and a preliminary report?

(5)—Are consulting engineers primarily interested in the size of the fee rather than pollution abatement at lowest cost?

(6)—Is industry justified in saying that consulting engineers cannot solve industry's problems as well as industry's own technical staff?

And Some of the Answers

I think you can pretty well guess what some of the answers were.

No one believed that a pollution control agency should advise an industry what to do or how to do it.

No one present argued strongly for effluent standards, although we both know that there are those who do believe that the yard-stick in pollution control should take the form of effluent standards in preference to stream standards.

Engineers generally don't think equipment manufacturers should deal directly with industry. Equipment men feel otherwise *when* the process to be used has been developed by the manufacturer.

Several consulting engineers were quick to point out that sound engineering practice called for a survey and report before any estimate of either the solution or the cost is given.

About consulting engineer's knowledge of industrial problems there was a diversity of opinion. It was, however, apparent that industry believes that engineers often have not kept pace with the process industries.

Some Pertinent Comments

Since you and I have talked about this before, I know you'll be interested in what one engineer had to say. To begin with, he pointed out that the general discussion seemed to be confusing two distinct questions:

First: is there a logical place for the sanitary engineer on the technical staff of an industry having an industrial wastes problem. Second: is there a place for the consulting sanitary engineer in serving industry in its undertakings in solving industrial wastes problems.

In both cases, he said, the answer is "Yes". More and more process industries are employing young sanitary engineers to become members of a team to handle waste problems before the process is developed. More and more industries also are employing outside consultants to aid in these problems. But; as industries employ more sanitary engineers, will consulting engineers be needed less and less? Only the future can answer this question—which, none the less, is a good one.

Back in 1950 I addressed a query to the most prominent consulting sanitary engineering offices in the country. I received 40 replies to the question—"What per cent of your gross income represents services to industry?" The average at that time was 19 percent; but, without doubt, it has increased in the four years since then.

From the answers to another query addressed to consulting sanitary engineers the following is a summary.

Certain process industries have developed their own manuals of practice on waste treatment. These can be followed by competent engineers in the industry without calling in an outside consultant. A case in point is the Am. Petroleum Inst.; and the Mfgrs. Chemists Assn. has also developed a fine manual.

Many of the chemical process industries do not have waste pollution abatement manuals to turn to, but they do have competent chemical engineers who are familiar with their processes. If they need sanitary engineering advice they are likely to employ a young sanitary engineer to work as a part of a team, rather than employing a consultant.

Industries which have waste problems involving the removal of inert suspended solids are apt to go directly to equipment manufacturers who can supply waste treatment equipment sized for the particular problem. Direct sales of such equipment are more common if the industry has earlier bought other equipment from the equipment manufacturer.

However, for industries dealing with organic wastes (foods, pharmaceuticals, etc.) the consulting engineer is frequently called in because a biological treatment process is indicated. Such treatment is familiar to consulting sanitary engineers since much of the development of these biological processes has been done by sanitary chemists and sanitary engineers. Incidentally, the equipment manufacturer's representative on the A.S.C.E. panel in essence said the same thing.

I think the A.S.C.E. discussion gave everyone something to think about and, since you are a budding sanitary engineer, I thought you'd be interested in this "thumbnail" sketch of what transpired.

Yours, Mike

Disposal of Sewage Sludge

12th in a Series

by DON E. BLOODGOOD

Mr. Bloodgood is Professor of Sanitary Engineering, Purdue Univ., Lafayette, Ind. In this series, he discusses *Sewage Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

THE concentrated solids removed from sewage by sedimentation processes are termed sewage sludge. These solids must be disposed of in a satisfactory manner.

There are several types of sludge, and each is generally identified by a word describing the method of removal.

Primary sludge is made up of the solids settling to the bottom of the primary tanks.

Imhoff sludge is the digested solids removed from Imhoff tanks.

Septic tank sludge is that material removed from septic tanks when they are cleaned.

Waste activated sludge is the excess solids removed from the activated sludge units to maintain a uniform quantity in the treatment plant.

Secondary sludge, or humus, is that sludge removed from the secondary settling tanks of trickling filter plants.

Chemical sludge is the solids removed by chemical treatment.

Digested sludge is the material removed from the bottom drawoff line of a digestion tank.

There are numerous methods available for disposing of these sludges. They may be disposed of directly or they may be converted to some other form prior to disposal. Not all sludges can be disposed of in the same way because of the differing nature of the materials. For instance, primary sludge cannot be disposed of by spreading it in liquid form on farm land, but the disposal of well-digested sludge by this means is one of the accepted methods. There is no one best method for the disposal of sewage sludges.

The characteristics of the various sludges will be discussed, and some of the suitable methods for their disposal will be described.

Primary Sludge Characteristics

Primary sewage sludge is a thick grayish liquid containing from two to six per cent solids. It has an odor that is generally objectionable. While there is a considerable amount of fecal solids in primary sludge, the odor is not that associated with fresh fecal matter. There is also used soap precipitated in this sludge, along with some greases that are weighted down with heavier materials. Some of the greases may become rancid and give a distinguishing odor to the sludge.

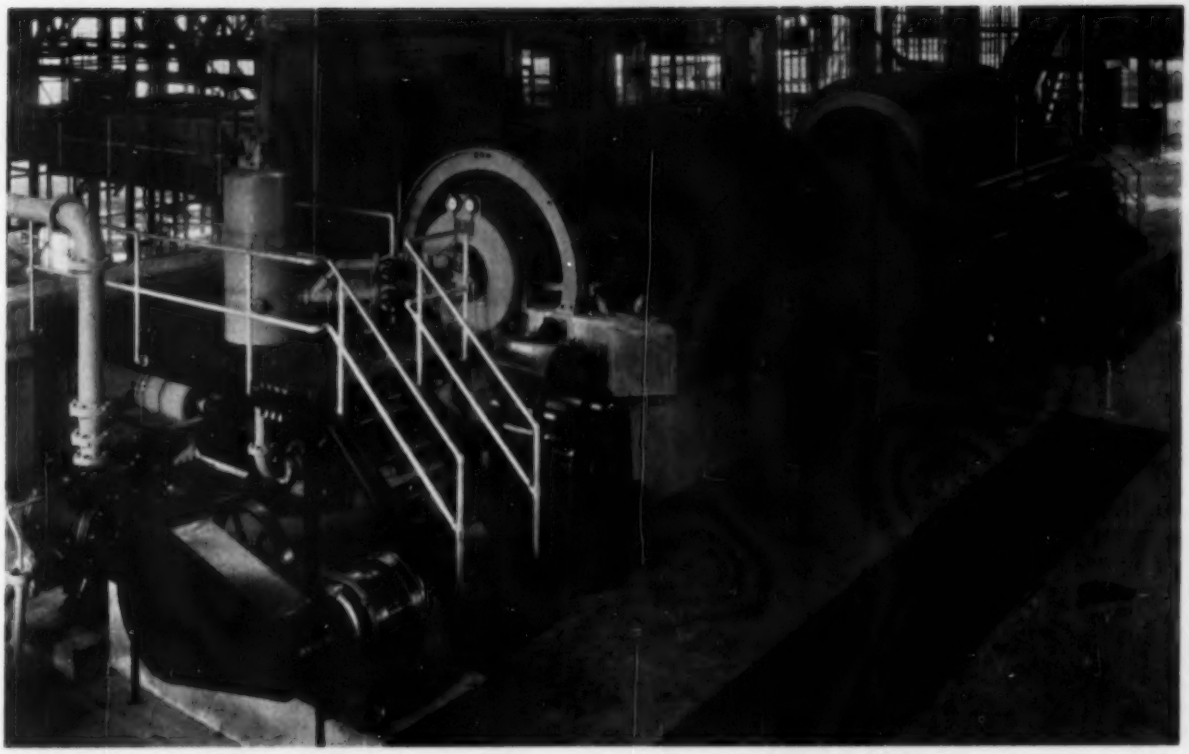
As the primary sludge is made up of raw solids, it therefore contains many bacteria. Some of the bacteria found in primary sludge are pathogenic; that is, produce diseases in human beings. There are larger numbers of dangerous bacteria in primary sludge than there are in sludge that has undergone more extensive treatment.

Primary sludge has a slimy quality and, because of this characteristic, it is almost impossible to dry primary sludge on drying beds.

In some sewage treatment plants, the primary sludge is mixed with chemicals to make it easier to remove the water from the solids prior to filtration on vacuum filters. The chemicals most often used for this "conditioning" treatment are lime, ferric chloride, ferric sulphate and filter alum. All these chemicals are not used together, but it has been found that definite quantities of one or combinations of two of these chemicals are required to give the most satisfactory sludge cake when the chemically conditioned sludge is dewatered.

While chemical coagulants reduce

SLUDGE DRYING BEDS—"Greenhouse" covers these at Towanda, N. Y.



VACUUM FILTERS—Conditioned sludge is dewatered on these units at the Dearborn, Mich., treatment plant.

the numbers of bacteria in the sludge, the filter cake still will contain many bacteria; therefore the cake cannot be safely spread on land or used for fertilizer as a means of final disposal. Usually the cake from vacuum-filtered primary sludge is put through an incinerator and completely burned, the organic solids in the cake furnishing enough fuel to dry out the moisture and ignite the solids.

Digestion of Primary Sludge

Primary sludge is most often digested in separate sludge digestion tanks or in lagoons. It has been pointed out previously that, in the digestion process, anærobic decomposition destroys a considerable amount of organic solids. The digestion process also brings about a physical change in the sludge: Sludge loses its grayish color and becomes very black. The odor of well-digested sludge resembles that of tar. Many bacteria that cause disease will be destroyed in the digestion process, so there is less danger in the disposal of digested sludge.

Several cities dispose of the digested sludge by "liquid sludge disposal." Using this method, the digested sludge is hauled by tank truck and spread on farm land. This practice of sludge disposal has been successfully employed for a number of years at Marion, Indiana. Of course, a considerable amount of water must be transported when this method is used. As a matter of information, it is necessary to haul one ton of liquid sludge in order to dispose of 200 pounds of dry solids. There is definite fertilizing value in digested sludge.

Drying on Sand Beds

At some treatment plants the digested primary sludge is placed on sand drying beds, the water is allowed to drain from it, and the remaining solids dry by exposure to the air. This dewatering and drying process proceeds quite satisfactorily in the summer months, but in the winter months drying becomes difficult—even though the drying beds may be covered by a glass structure.

The sludge cake that forms on drying beds is not completely dry; in fact, the cake as removed from the drying beds contains from 55 to 70 per cent moisture. This means that when one ton of cake is removed from a bed, only 600 to 900 pounds of dry solids are removed.

The cake from the drying beds is sometimes further dried so that it contains less than ten per cent moisture. This is done by passing the cake through a heat drier. Material dried to this extent can safely be bagged and sold as a mulch fertilizer. Digested sludge has been processed in this manner at Dayton, Ohio.

It is not usual practice to incinerate digested sludge, because there is a definite loss of combustible organic matter in the digestion process, and the digested sludge solids do not contain enough heat value to evaporate the moisture and burn.

Drying on Vacuum Filters

Digested sludge can be treated with the previously mentioned conditioning chemicals, and then dewatered on vacuum filters. This method of disposal eliminates the use of the sludge drying beds. The filter installation requires less space than do the drying beds, and the filters operate without interference from the weather. Vacuum filter cake can be hauled in dump trucks, and can be piled or used to fill low ground.

Benefits of Digestion

Digested sludge can be shipped by boat to authorized dumping grounds. There is an advantage in using digestion prior to this method of disposal, in that fewer pounds of sludge remain to be hauled away. Also, the

digested solids are less of a health hazard than are raw primary sludge solids when dumped at sea. Digestion prior to disposal makes it possible, in addition, to obtain valuable gas that can be used as fuel for heat or power generation.

Imhoff Sludge Characteristics

The sludge from Imhoff tanks is very similar to primary sludge that has been digested in a separate sludge digestion tank. Well-digested Imhoff sludge can be disposed of by all of the methods that are used for the disposal of digested primary sludge.

Septic Tank Sludge Characteristics

The sludge that accumulates in a septic tank digests by anærobic decomposition in the same manner that primary sludge decomposes in separate sludge digestion units or in Imhoff tanks. A septic tank serves both as the settling tank and the digestion tank. Consequently, there may be raw sludge solids floating on the top of the tank.

In cleaning the small septic tank some of the scum may be removed along with the digested solids at the bottom of the tank. This combination of raw solids and digested sludge is much more difficult to dispose of than is well-digested sludge.

Municipalities should provide a suitable location for dumping septic tank sludge, so that there will not be promiscuous dumping in areas where dumping could endanger the public health by contamination of streams or wells. Some cities license operators of equipment for cleaning septic tanks. In this way the city maintains control, and can guarantee that sanitary equipment will be used.

The city can also require that the sludge be disposed of in a satisfactory manner. It is desirable to have sludge from septic tanks dumped into a lagoon, so that further decomposition can proceed, and so that sludge will be suitably treated.

Waste Activated Sludge Characteristics

Waste activated sludge usually is brown in color. When first discharged from the settling tank it has an earthy smell somewhat resembling the decomposition of rotting leaves or stumps; however, in the absence of air, anaerobic decomposition soon takes place and the odors then given off may be quite objectionable. The large numbers of bacteria in the activated sludge consist mostly of types that have grown and multiplied in the sludge, using the suspended and dissolved solids of the sewage as food. The solids concentration in waste activated sludge is much less than in primary sludge, being usually not more than one per cent.

In a number of sewage treatment plants, waste activated sludge is mixed with the incoming raw sewage and thus settles out with the raw sewage solids in the primary settling tank. There are advantages and disadvantages in using this method. The waste activated sludge may help to flocculate some of the sewage solids and, as a result, a greater removal of solids should take place in the primary tanks. In addition, there is some indication that a mixture of activated sludge and primary sludge will result in a higher concentration of combined sludge solids than could be obtained if the two sludges were settled separately.

Wasting activated sludge to the primary tanks is troublesome when the activated sludge is "bulky" sludge. Bulky sludge is so light that not all of it will settle in the primary tank, and sludge solids will be carried back into the aeration units. Only the lightest of the activated sludge gets back to the aerators, thus adding more undesirable sludge to that which is already so light that it will not settle well.

Digestion of Activated Sludge

Activated sludge, either directly from settling units or after concentration, often is pumped directly to separate sludge digestion tanks. The activated sludge is mixed with primary sludge in the digestion tank. Activated sludge decomposes as readily as the primary sludge, and the digested sludge solids can be disposed of by all methods previously described for the disposal of digested primary sludge.

Vacuum Filtration and Drying

Waste activated sludge solids taken directly from the secondary settling units can be filtered by vacuum filtration if the sludge is first conditioned with ferric chloride, ferric sulphate, chlorinated copperas, or filter alum. In most cases, ferric chloride is the most satisfactory coagulant. After filtration the waste activated sludge filter cake still contains about 80 to 83 per cent moisture. The cake can be handled by forks, but is not dry enough to prevent aerobic decomposition; consequently, the filter cake cannot be piled or stored for any length of time without causing a nuisance.

The activated sludge filter cake usually is passed through a hot air drier immediately after it comes from the vacuum filter. Drying reduces the moisture content to below ten per cent. In this condition the sludge solids can be stored indefinitely if kept dry.

The dried filter cake is sold for fertilizer. The Milwaukee Sewerage Commission, the Chicago Sanitary District, and the City of Houston are the largest producers of this dried activated sludge.

New York City transports waste activated sludge by barge out to a dumping ground at sea. The sludge is dumped so far from shore that no serious problem of gross pollution is created.

Sewage Sludge as a Fertilizer

A comparison between the fertilizer values of sewage sludges and animal manures is shown by the analyses given in Table 1.

TABLE 1

Comparative Fertilizer Values (%)

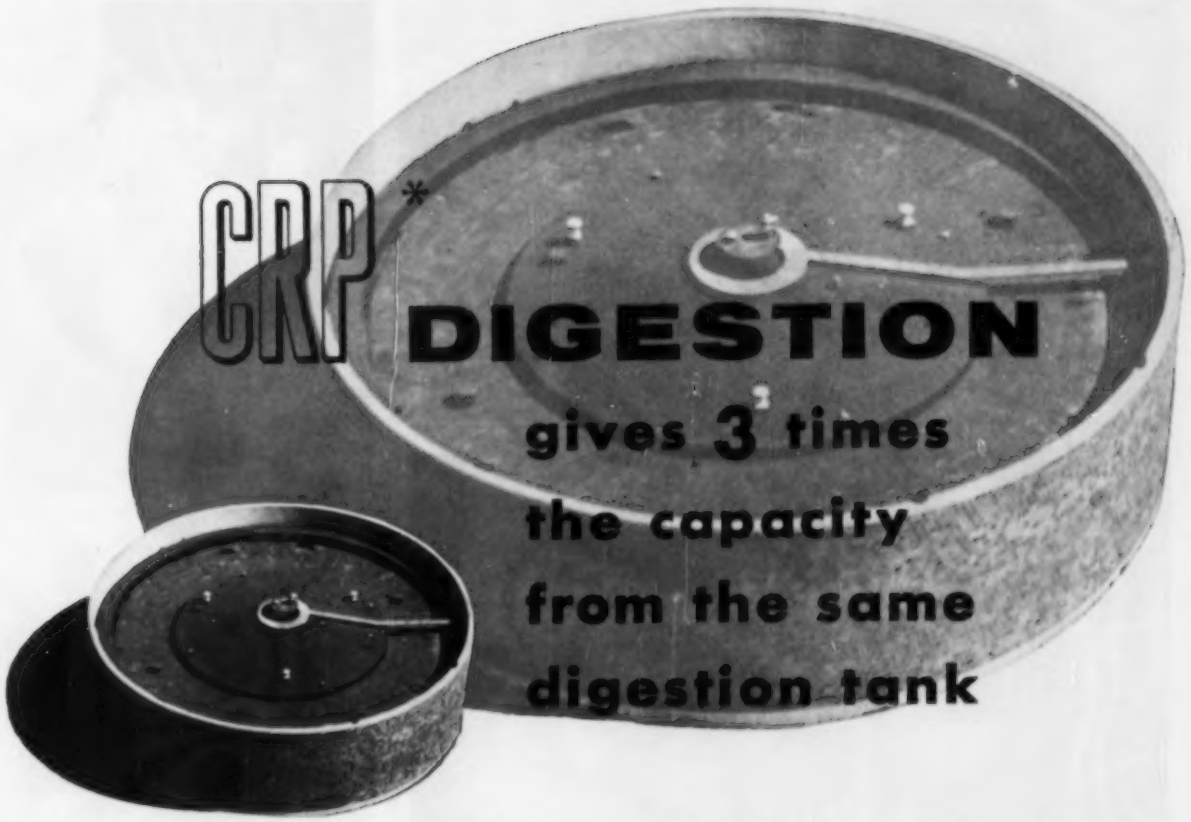
	Nitrogen	Phosphoric Acid	Potash	Moisture
Sewage Sludge:				
Digested (Dried)	2.09	1.63	0.26	6.37
Dig. (From Beds)	0.19	0.14	0.02	70.0
Activated (Dried)	5.50	2.10	0.13	10.0
Sheep Manure	1.40	0.50	1.20	64.0
Poultry Manure	1.40	1.00	0.40	68.0
Cow Manure	0.60	0.22	0.60	79.0

All sewage sludges contain organic matter, nitrogen, phosphoric acid, and potash—constituents that are of value in fertilizers. Not all sludges contain the same concentration of these materials, and thus the sludges do not have equal fertilizing value. The fertilizing value is contained in the solids, so that the more moisture a sludge contains the lower will be the fertilizing value.

Some nitrogen, phosphate, and potash are lost in anaerobic decomposition. It is for this reason that digested sludge is not as good a fertilizer as that produced directly from activated sludge.

Summary

There are many methods for the disposal of sewage sludges. Local conditions largely govern in choosing the method most suitable for a particular municipality.



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The CATALYTIC REDUCTION PROCESS applied to one 70′ tank at the Columbus Plant digested 3.38 times the quantity of sludge solids digested in a similar tank in parallel operation not using the PROCESS. The tank operating under the PROCESS produced a reduction of solids within established ranges, normal gas production and readily driable odorless sludge.

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W&SW

Spillway

OVERFLOW FROM THE MAIN SECTION

Philadelphia Largest City To Adopt Fluoridation

In September, 1954, Philadelphia, Pa., joined the vanguard of the second thousand U. S. cities (Osawatomie, Kas. was 1,000th) to inaugurate a fluoridation project. This city is the largest community in the world to provide its residents with fluoridated water.

The program which affects a population of 2,131,700, using as much as 555 millions of gallons of water per day, is a step calculated to reduce dental decay drastically, particularly among children. City officials, especially Mayor Joseph S. Clark, Jr., have taken a special interest in fluoridation.

Mayor Clark and Water Commr. Baxter start first fluoride feeder.

The entire operation was carried out under the direction of Philadelphia Water Commissioner, Samuel S. Baxter, Gerald E. Arnold, General Supt., Water Operations, and Elwood L. Bean, Chief, Water Treatment with the assistance and advice of the consulting engineers, Morris Knowles, Inc., of Pittsburgh.

Proportioneer's Chem-O-Feeder was selected to perform the job of adding hydrofluosilicic acid to the flow of treated and filtered water. Ten units apply fluoride at all five of Philadelphia's filter plants: Queen Lane, Torresdale, Belmont, and Upper and Lower Roxborough. Total costs of all feeders came to less than five thousand dollars.

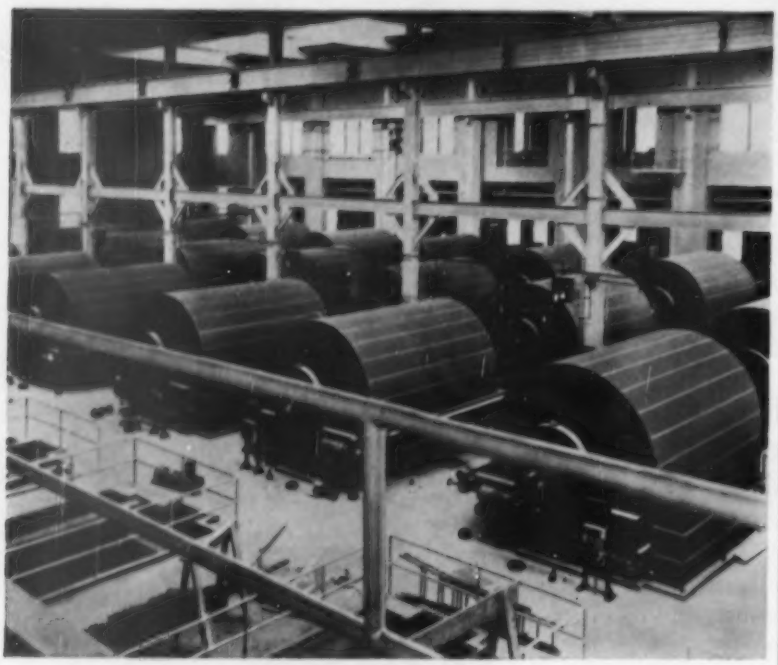
Southern IW Conference Proceedings Published

Complete proceedings of the 1954 Southern Industrial Wastes Conference are now available, it has been announced by Manufacturing Chemists' Association, Inc.

Included in the 210-page proceedings are the 22 papers which were presented at the three-day conference held last April in Houston, Texas.

The conference was sponsored jointly by Southern Association of Science and Industry, Inc., Texas Chemical Council and MCA.

Copies of the proceedings are available through the Manufacturing Chemists' Association, 1625 Eye Street NW, Washington 6, D. C., at $2.50 per copy.



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Laurels for Oldest American Cast Iron Mains Pass to Montreal

Recent excavations in Montreal, Canada, uncovered what are now believed to be the oldest known water mains still in service on the North American continent.

Philadelphia's Mains Second Oldest

Several thousand feet of cast iron pipe, which records show to have been laid 138 years ago are still in excellent operating condition.

Impressed by the unusual design of the pipe (see picture), the foreman in charge of the excavation called this to the attention of Frank V. Dowd, superintending engineer of the water system. A search of the records proved that the pipe had been installed in 1816 to replace original wooden mains laid in 1800.

Until Montreal uncovered this 1816 pipe, the Cast Iron Pipe Research Association believed that the oldest cast iron pipe still in service was that installed in Philadelphia in 1819.

Something of a record-breaker himself, Frank Dowd and his forebears have given 123 years of service to the Montreal system. He joined the department in 1909, and his father and his grandfather also worked for the water utility. In the picture Mr. Dowd is pointing to some of the unusual design features of the old cast iron pipe.

Des Moines Sewage Sludge Sold for Fertilizer

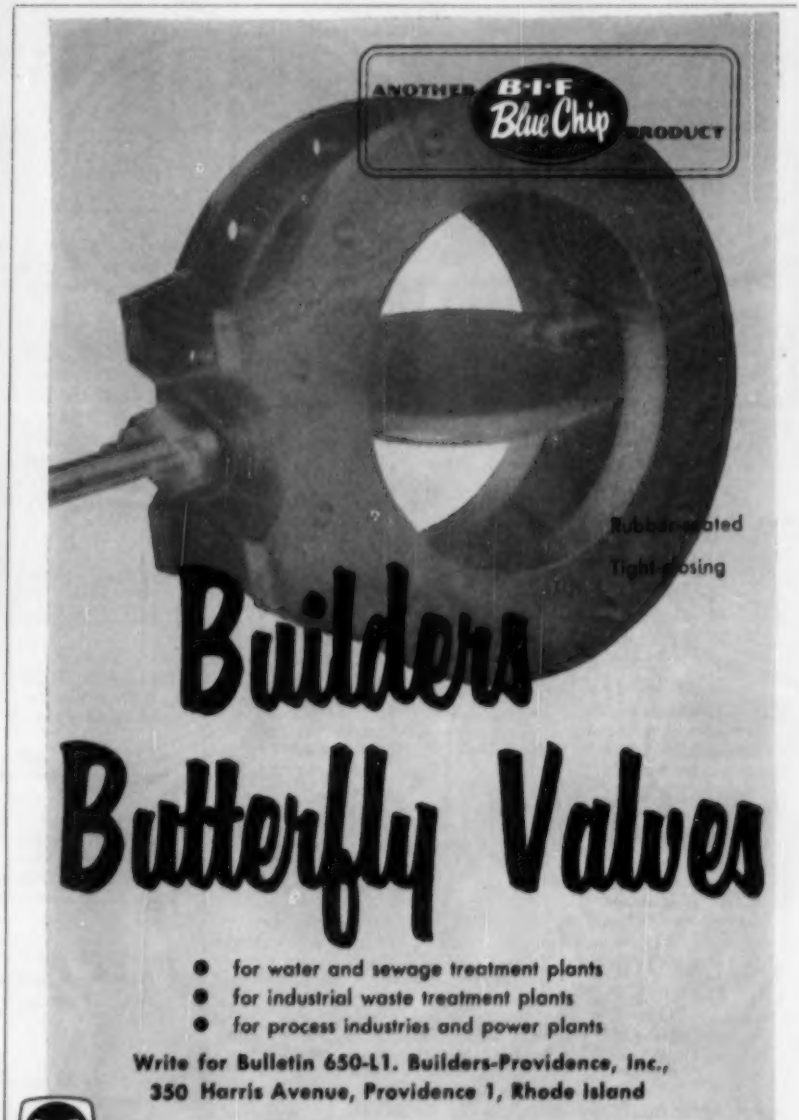
The Des Moines city council has given two local attorneys permission to assume the contract for purchase of sludge from the sewage treatment plant for use in producing commercial fertilizer.

The council members were told that, while the plant now did not produce enough sludge to make the fertilizer production profitable, it was hoped that increased volume of sludge resulting from the treatment plant renovation and enlargement would make for eventual profit.

New Use for Water . . .

George Frantum, a service station attendant, told Baltimore police he was washing a car recently when a man approached him from behind and said, "Gimme your money."

Frantum said he whirled around and squirted water in the man's face. The would-be holdup man gave a yell and fled.



W & SW

Meetings Scheduled

Jan. 18, 1955—New York, N. Y. *(Sheraton Hotel)* Grand Ballroom
NEW YORK SECTION A.W.W.A. (Mid-Winter Luncheon Meeting). Sec'y, Kimball Blanchard, 56 Grand Street, White Plains, N. Y.

Jan. 20—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Jan. 20-21—New York, N. Y. *(Hotel Belmont Plaza)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, R. C. Sweeney, 21 No. Broadway, White Plains, N. Y.

Feb. 8-9—Portland, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Feb. 9—Newark, N. J.
NEW JERSEY SECTION A.W.W.A. (Winter Luncheon Meeting). Sec'y, C. B. Tygert, Box 178, Newark, N. J.

Feb. 9-11—Indianapolis, Ind. *(Lincoln Hotel)*
INDIANA SECTION A.W.W.A. Sec'y, R. J. Becker, 1330 W. Michigan Street, Indianapolis, Ind.

Feb. 17—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Feb. 17-18—Columbus, O. *(Ohio State Univ.)*
OHIO WATER CLINIC. (4th Annual Conference). Director, Kenneth W. Cosens, Ohio State Univ., Columbus, O.

Mar. 6-11—College Station, Tex. *(Texas A & M)*
TEXAS WATER & SEWAGE WORKS ASSOCIATION. Sec'y, V. M. Ehler, 2202 Indian Trail, Austin, Tex.

Mar. 7-11—Chicago, Ill. *(Palmer House)*
NATIONAL ASSOCIATION OF CORROSION ENGINEERS. Sec'y, A. M. Campbell, 1061 M & M Bldg., 1 Main St., Houston, Tex.

Mar. 9-12—Boston, Mass. *(Sheraton Plaza Hotel)*
AMERICAN CONCRETE PIPE ASSOCIATION. Director, Howard F. Peckworth, 228 No. LaSalle St., Chicago, Ill.

Mar. 18—Trenton, N. J.
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSOCIATION. (1 day meeting). Sec'y, M. S. Kachorsky, P. O. Box 766, Manville, N. J.

Mar. 21-23—Savannah, Ga. *(DeSoto Hotel)*
SOUTHEASTERN SECTION A.W.W.A. Sec'y, N. M. de Jarnette, 245 State Office Bldg., Atlanta, Ga.

Apr. 13—Bangor, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Apr. 13-15—Hutchinson, Kans. *(Baker Hotel)*
KANSAS SECTION A.W.W.A. Sec'y, H. W. Bradley, 119 West Cloud, Salina, Kans.

Apr. 13-15—Lincoln, Neb. *(Cornhusker Hotel)*
NEBRASKA SECTION A.W.W.A. Sec'y, E. Bruce Meier, Univ. of Nebraska, Lincoln, Neb.

Apr. 14-16—Chandler, Ariz. *(San Marcos Hotel)*
ARIZONA SECTION A.W.W.A. Sec'y, Q. M. Mees, Univ. of Arizona, 721 N. Olsen Ave., Tucson, Ariz.

Apr. 14-16—Chandler, Ariz. *(San Marcos Hotel)*
ARIZONA SEWAGE & WATER WORKS ASSOCIATION. Sec'y, Quentin M. Mees, 721 N. Olsen, Tucson, Ariz.

Apr. 18-20—Quebec, Can. *(Chateau Frontinac)*
CANADIAN SECTION A.W.W.A. Sec'y, Dr. A. E. Berry, Dept. of Health, Parliament Buildings, Toronto, Ont., Can.

Apr. 20-22—Buffalo, N. Y. *(Statler Hotel)*
NEW YORK SECTION A.W.W.A. Sec'y, Kimball Blanchard, 56 Grand Street, White Plains, N. Y.

Apr. 27-30—Riverside, Calif. *(Mission Inn)*
CALIFORNIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, J. C. Mallery, 4822 Dunsmore Ave., LaCrescenta, Calif.

Apr. 29-30—Butte, Mont. *(Finlen Hotel)*
MONTANA SECTION A.W.W.A. Sec'y, A. W. Clarkson, State Dept. of Health, Helena, Mont.

May 4-6—Pittsburgh, Pa. *(Hotel Webster Hall)*
PENNSYLVANIA SECTION A.W.W.A. Sec'y, L. S. Morgan, State Dept. of Health, Greensburg, Pa.

May 19-21—Yakima, Wash. *(Chinook Hotel)*
PACIFIC NORTHWEST SECTION A.W.W.A. Sec'y, F. D. Jones, Room 305, City Hall, Spokane, Wash.

May 25—Trenton, N. J. *(Tentative)*
NEW JERSEY SECTION A.W.W.A. (Summer Outing). Sec'y, C. B. Tygert, Box 178, Newark, N. J.

June 8—Bar Harbor, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

June 12-17—Chicago, Ill.
AMERICAN WATER WORKS ASSOCIATION. (75th Annual Convention). Exec.-Sec'y, Harry E. Jordan, 521 Fifth Avenue, New York 17, N. Y. (All reservations being cleared through A.W.W.A. office.)

June 13-14—Albany, N. Y. *(Hotel Ten Eyck)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, R. C. Sweeney, 21 No. Broadway, White Plains, N. Y.
(joint meeting with)

June 13-14—Albany, N. Y. *(Hotel Ten Eyck)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Stephen M. Hurley, Jr., 331 State Office Bldg., Providence, R. I.

Aug. 15—Richmond, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Aug. 22-24—State College, Pa. *(College Dormitories)*
PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION. Sec'y, R. Rupert Kountz, Penn. State University, State College, Pa.
(joint meeting with)

Aug. 22-24—State College, Pa. *(College Dormitories)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, B. B. Bush, State Dept. of Health, Kirby Health Center, Wilkes Barre, Pa.

Sept. 7-9—Saranac, N. Y. *(Saranac Inn)*
NEW YORK SECTION A.W.W.A. Sec'y, Kimball Blanchard, 56 Grand St., White Plains, N. Y.

Sept. 12-14—Lexington, Ky. *(Phoenix Hotel)*
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, S. Leary Jones, 420 Sixth Ave., Nashville, Tenn.

Sept. 12-14—Lexington, Ky. *(Phoenix Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, J. Wiley Finney, Jr., 553 S. Limestone St., Lexington, Ky.

Sept. 14-16—Flint, Mich. *(Durant Hotel)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, State Dept. of Health, Lansing, Mich.

Sept. 18-22—Lake Placid, N. Y. *(Lake Placid Club)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Sept. 21-23—Columbus, O. *(Neil House)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, O.

Sept. 21-23—Milwaukee, Wis. *(Hotel Schroeder)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison, Wis.

Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATION. (Annual Meeting). Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.
(joint meeting with)
Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, M. S. Kachorsky, P. O. Box 766, Manville, N. J.

Oct. 12—Norridgewock, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 16-19—San Antonio, Tex. *(Gunter Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 19-21—Des Moines, Ia.
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Ia.

Oct. 20-22—Atlantic City, N. J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. (Fall Meeting). Sec'y, C. B. Tygert, Box 178, Newark, N. J.

Oct. 24-28—New York, N. Y. *(Hotel Statler)*
AMERICAN SOCIETY OF CIVIL ENGINEERS. (Annual Meeting). Sec'y, Wm. N. Carey, 33 West 39th St., New York, N. Y.

Oct. 25-28—Sacramento, Calif. *(Senator Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, Henry F. Jerauld, 1040 Manzanita, Pasadena, Calif.

Oct. 26-28—Washington, D. C. *(Hotel to be announced)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl J. Lauter, 6955—33rd St., Washington, D. C.

Dec. 14—Augusta, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Jein

PORTABLE AUTOMATIC PIPE CUTTERS

with Pneumatic or Electric Drive

for Cast Iron and Steel Pipe from 6" to 60" diameter

- Weight: only 145 lbs.
- Clearance: 12" max. around pipe.
- Set up time: 5-10 min. by 1 or 2 unskilled men.
- Machines operate under water.
- Cuts 8" pipe in 5 min.—24" in 18 min.
- Also available: "V" cutter for welded steel pipe.

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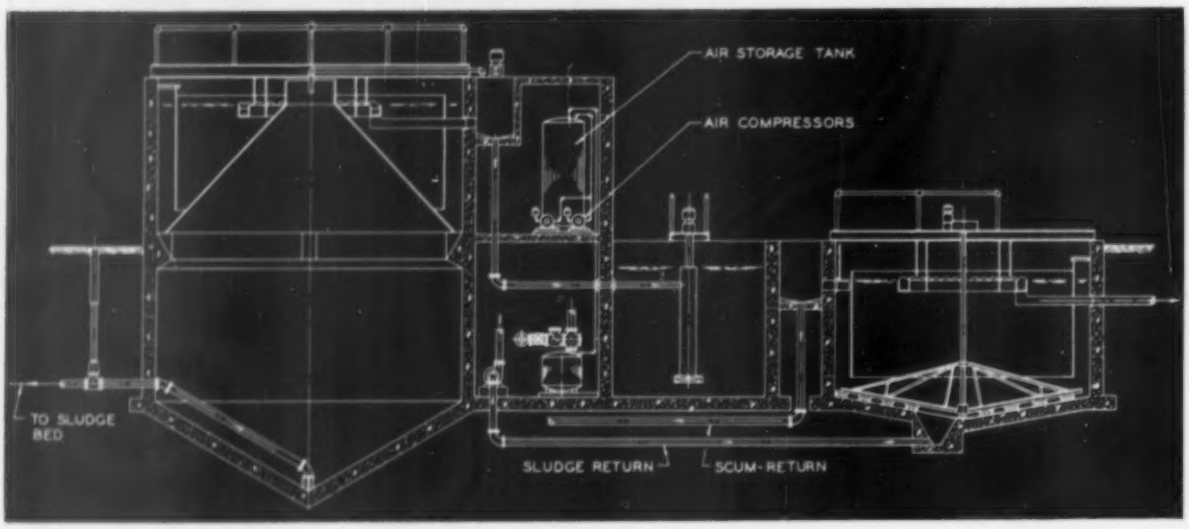
THE Cavitation SYSTEM

For Municipal Waste Treatment



One of the many possible arrangements is illustrated. The secondary treatment is provided by the Cavitator mechanism, a specially designed rotor with two arms mounted on a hollow shaft through which air is drawn for dispersion through the tank contents. The arms are streamlined with the outer ends so constructed that when they are passed through the liquid at relatively high speeds they create a zone of cavitation through which the liquid is recirculated continuously. Air and liquid are drawn into the cavitation zone under vapor pressure conditions. As the bubbles rise they implode with such tremendous force that the pressure actually drives the oxygen into the tank.

- **high oxygen transfer efficiency**—requires only 120 cu. ft. of air per lb. B.O.D. removal.
- **exceptional performance on low flows** with high B.O.D.
- **low installation and operating cost** with a high degree of purification.

Primary clarification and digestion is accomplished in a single structure, the Spiragester. A Spiraflo is used for clarification.

Secure detailed information. See your local Yeomans representative listed in the Yellow Pages of your telephone book under "Pumps" or contact factory direct.

Yeomans Brothers Company, 1999-9 N. Ruby Street, Melrose Park, Illinois

Manufacturers of: Distributors • Clarifiers • Digesters • Mechanical Aerators • Pneumatic Sewage Ejectors • Centrifugal Pumps

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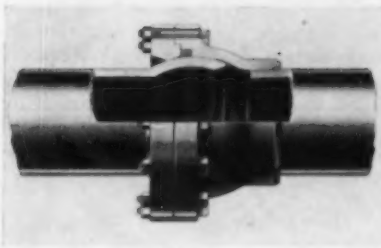
W&SW

New Equipment

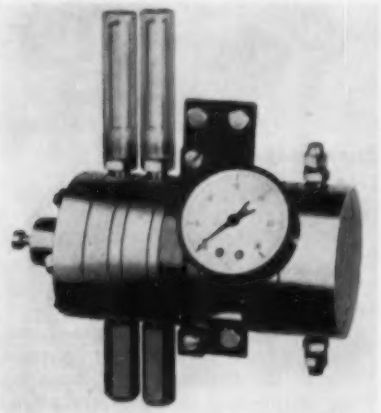


New River-Crossing Pipe

101

James B. Clow & Sons, Chicago, Illinois, has developed a new river-crossing that may be deflected as much as 15° without impeding the flow of the pipe's contents. The reason for this free-flowing characteristic, even with extreme deflection, lies in the new ball-and-socket design.

Other advantages claimed for this pipe are: only 3 pieces to each joint (1 complete pipe, 1 solid follower ring, 1 solid ring gasket), besides the bolts and nuts; no split parts; rubber gasket symmetrical in cross section, and cannot be installed the wrong way. Lower labor installation costs result from the greater ease of joint make-up, Clow asserts, and from the longer laying lengths (approximately 18'6" long).



BalanCel Pneumatic Transmitter

102

Builders-Providence, Inc., Division of B-I-F Industries, Inc., Providence, R. I., has announced the development of a unit to meet the need for a low cost, simple, sensitive transmitter, designed especially for water filtration, sewage and low pressure industrial service.

Known as the BalanCel Pneumatic Transmitter, Model ATD, this unit is compact (only 7 in. long, 3 in. diameter, and 4 lb. weight), operates on the force-balance principle, and delivers a pneumatic output pressure, changes in which are exactly proportional to changes in loading pressures. The output may be a direct or inverse function of a single loading pressure or of the difference or sum of more than one loading pressure. Small diameter tubing between the

(Continued on page 100A)

"Out of sight—out of mind" can be a mighty expensive philosophy in any water distribution system. The above unretouched photograph proves this point. It shows a badly tuberculated *eight inch* main whose *inside diameter was reduced to an average of almost 4.5 inches.* Resultant higher pumping costs with reduced pressure and carrying capacity make it costly to tolerate such conditions. That is why the savings effected in reduced pumping costs frequently pay for the *low cost* of National water main cleaning.

Since there's never a charge or obligation to inspect your mains, *call National now!*

Call in National today!

NATIONAL WATER MAIN CLEANING COMPANY

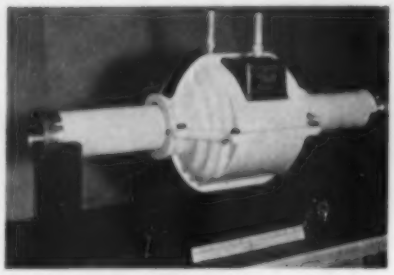
50 Church Street • New York, N. Y.

ATLANTA, GA; 333 Candler Building • BERKELEY, CALIF; 905 Grayson Street • DECATUR, GA; P. O. Box 385 • BOSTON, MASS; 115 Peterboro Street • CHICAGO; 122 So. Michigan Avenue ERIE, PA; 439 E. 6th Street • FLANDREAU, S.D.; 315 N. Crescent Street • KANSAS CITY, MO; 406 Merchandise Mart and 2201 Grand Avenue • LITTLE FALLS, N.J.; BOX 91 • LOS ANGELES; 5075 Santa Fe Avenue • MINNEAPOLIS, MINN; 200 Lumber Exchange Building • RICHMOND, VA; 210 E. Franklin Street • SALT LAKE CITY; 149-151 W. Second South Street • SIGNAL MOUNTAIN, TENNESSEE; 204 Slayton Street • MONTREAL, CANADA; 2032 Union Avenue • WINNIPEG, CANADA; 576 Wall Street • HAVANA, CUBA; Lawrence H. Daniels, P.O. Box 531 • SAN JUAN, PUERTO RICO; Luis F. Carattini, Apartado 2184.

(Continued from page 99A)

transmitter and the remote instrument conveys the pneumatic signal which actuates the instrument mechanism.

The BalanCel Transmitter is ideally suited for measuring rate of flow, loss of head, liquid level, and pressure (up to 35 psi). It is equally well suited to the summation or averaging of two or more quantities. The Transmitter is simple to install and contains no delicate or complicated parts, is not affected by air supply pressure changes, has a minimum output pressure of 3 psi and is free from zero drift.



New Magnetic Meter Handles Larger Lines, Unlimited Flows

103

The Foxboro Company, Foxboro, Mass., has developed a new electromagnetic flow meter, designed for 2″ to 8″ flow lines. Incorporating all the unique advantages of electromagnetic metering, the instrument is additionally rated for unlimited maximum flows, making practical a number of flow measurement applications impossible with ordinary metering equipment.

The Foxboro Magnetic Flow Meter will measure the volume flow rate of any liquid of sufficient conductance and velocity. Unaffected by the pressure, viscosity, density or changes in conductivity of the flowing liquid, it is recommended for aqueous solutions, slurries, acids and other corrosives.

The unit consists of a nonmagnetic flow tube with an insulating liner containing flush-mounted metallic electrodes and surrounded by an AC electromagnet. When conductive liquid passes through the tube, an alternating voltage is set up between the electrodes which varies linearly in proportion to the rate of the flow. Lead wires from the electrodes transmit this voltage output to a new type Dynalog (electronic) Recorder, producing a chart record in appropriate units of flow.

Over-all accuracy is within ±1% of the scale span from maximum flow down to zero flow despite such factors as turbulence, dirty flow, etc. Meter produces no more pressure drop than a length of pipe equivalent to the meter tube.

Electric motor operation is recommended for large M & H Gate Valves, or where valves are frequently operated, or where valves are located in remote, inaccessible or hazardous places. The remote control, possible with electric motor operated M & H Valves, is a convenience which frequently increases efficiency and reduces operating costs.

The 36″ motor operated M & H Valve illustrated here is standard M & H Gate Valve design and construction—iron body, bronze mounted, double disc, parallel seat. All sizes of electric motor operated M & H Gate Valves are available in Class A for 50 lbs. working pressure, Class B for 100 lbs. working pressure or A.W.W.A. Class C for 150 lbs. working pressure. Furnished with hub, flanged or mechanical joint ends.

M & H Gate Valves may be ordered equipped also with usual accessories such as gearing, by-passes; rollers, tracks and scrapers; double square bottom, indicators, or for hydraulic cylinder operation. For complete information, write or wire M & H Valve and Fittings Company, Anniston, Alabama.

M&H PRODUCTS

FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

Easy-To-Use Pipe Line Scraper

104

The Carver-Stimpson Pipe Cleaning Co., Inc., Walters, Oklahoma has available the Flex-O Hydraulic Pipe Line Scraper.

According to the company, the Flex-O scrapers are simple to operate and will allow the user to clean his water mains and sewage force mains at his convenience at a fraction of the cost of contract cleaning.

The company also points out that with the scraper no experienced men are needed. The pipe line is simply cut to insert the scraper, and another cut is made at the end of the section to be cleaned for exit of the cleaner and cuttings. No rods or pulling devices are needed, only ordinary city pressure.

Charlab Washer

105

Fisher Scientific Company, Pittsburgh, Pa., has available the improved Fisher Charlab Washer with a new series of glassware baskets to extend the washer's versatility. In the new Charlab, according to Fisher engineers, everything from over-size graduates to micro pipettes can be accommodated. This includes large, odd-shaped funnels and flasks that are not usually handled by mechanical washers.

Large pieces of glass are locked directly in place with the Charlab's unique screens-and-rods combination (these screens and rods fit into the constellation of holes drilled into heavy brass carrier discs). Smaller or special pieces—test tubes, syringes, microscope slides, Petri dishes—go into the new accessory baskets which are attached to the carrier discs with rods.

The revolving discs dip the loaded baskets and screens-and-rods combinations into the hot wash water; each piece of glassware *fills* with hot cleaning solution (160°F for most jobs, 212°F for such media as agar) . . . *soaks* . . . and *empties* again as the wheel goes around. The "heart" of the washer's thoroughness is this turbulent flow of hot wash water into, around, and out of the glassware.

Another major feature of the Charlab is its capacity. Although it needs only 20 x 40 inches of floor space, it accommodates, in one load, some 1300 test tubes plus 60 Petri dishes.

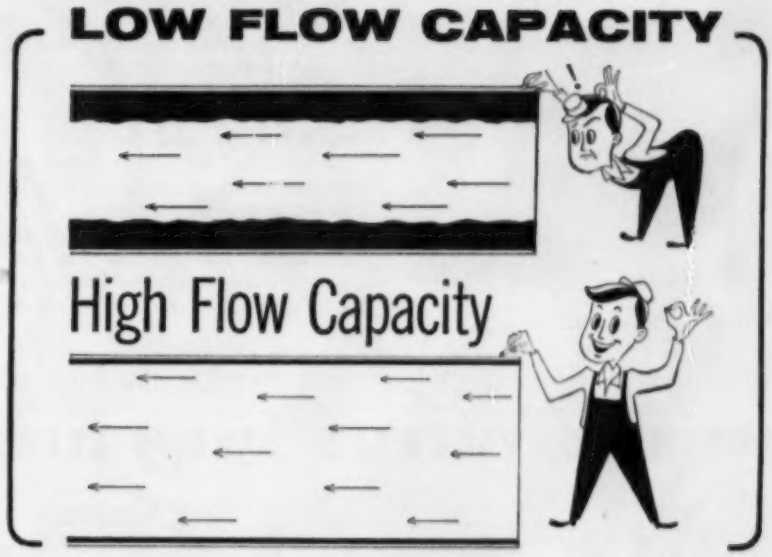
New Algaecide For Reservoirs

106

Wallace & Tiernan, Inc., Newark, N. J., has developed a new product called Algeeclear for the control of algae in pools and reservoirs.

Algeeclear is said to dissolve easily, remain in solution under adverse pH and alkalinity conditions and is more economical to use than Copper Sulfate. Wallace & Tiernan Algeeclear is a dry, granular mixture of a patented combination that does not precipitate in high pH and carbonate alkalinity water, is free of carbohydrates and will therefore not support bacterial growth.

Recommended for the control of algae is an initial dosage of 0.25 lbs. per 10,000 gals. of water with subsequent smaller amounts to continue control as required by the addition of make-up water.



Bitumastic 70-B Enamel

makes the difference by preventing corrosion

• Flow capacity *stays* high when Bitumastic® 70-B Enamel protects interior surfaces of steel pipe lines. This durable enamel prevents rust, corrosion, incrustation and tuberculation . . . keeps pipe lines from "shrinking." With this kind of protection, there's no need to spend money on *over-sized* pipe in order to allow for future loss in flow capacity. Flow tests conducted on steel pipe lines, centrifugally lined with hot Bitumastic 70-B Enamel, have shown the value of Hazen-Williams coefficient "C" = 145 to 160.

You can save money in another way with Bitumastic 70-B Enamel. When applied to a thickness of 1/32", it protects the exterior of pipe against the corrosive action of the soil. It is wasteful to specify an excess of wall thickness to compensate for corrosion. It is more economical to specify just enough wall thickness to give the pipe adequate structural strength and to use Bitumastic 70-B Enamel to prevent corrosion.

Use strong, durable steel pipe, lined and coated with Bitumastic 70-B Enamel, and give your community worthwhile savings. Write for full information on protecting large-diameter water lines.

KOPPERS BITUMASTIC ENAMELS

KOPPERS COMPANY, INC., Tar Products Division
Dept. 1022-T, Pittsburgh 19, Pennsylvania

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Rubberchem Pump

107

Eco Engineering Company, Newark, N.J. offer new displacement pump. Embodying the time-tried design and features of the Eco stainless steel and Teflon All-Chem pump, it now features precision molded synthetic rubber pump casings.

Suitable for corrosive fluids and capacities of up to ten GPM and 100 PSI for sustained service.

Ruggedly built, age-cured and fully stress relieved, the new Rubberchem pump offers the lowest cost pumping unit in its range of capacities.

Unexcelled suction lift, safety because of its self-priming design, and linear flow are standard features of this chemical service pump.

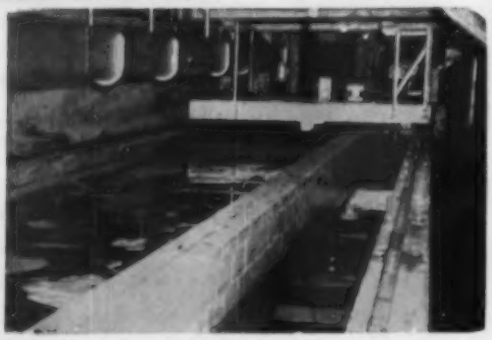
Ideal for the conveyance of chlorine bearing fluids, i.e., water, hydrochloric and other acids, as well as a great many alkalies and organic and inorganic fluids compatible with synthetic rubber.

AUTOMATIC BACKWASH SAND FILTERS

for WATER SUPPLY

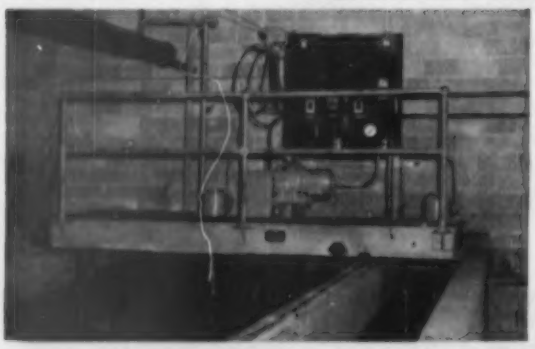
12½' x 40' Hardinge Automatic Backwash Sand Filter in a Vermont municipal water-treating plant. It cleans its own filter bed automatically. Highly efficient.

for TRADE WASTES



6' x 52' Hardinge Filter handling "white water" in a Canadian paper plant. No shut-down or change-over necessary for back-washing.

for SEWAGE

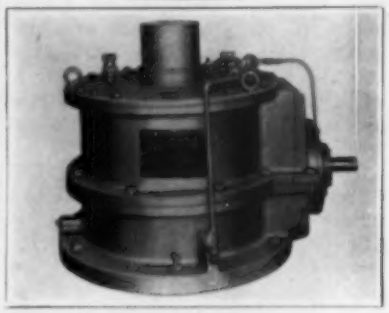


9' x 28' Hardinge ABW Sand Filter operating on sewage settling tank effluent at a sewage disposal plant in British Columbia. It runs indefinitely with very little attention.

HARDINGE COMPANY, INCORPORATED

YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works

New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco



Deep Well Pump Drive

108

Universal Gear Corp., Indianapolis, Ind., has developed a new flexible Deep Well Pump Drive PR-12 that provides any ratio up to 5:1.

Designed for connection of internal combustion engines to deep well pumps, this new drive may be used as either a speed reducer or increaser. Its horsepower capacity is 50 to 450.

The vertical shaft is hollow to permit passage of the pump shaft into the spin coupling hub. The split hub allows easy adjustment of the pump shaft to any desired position.

Anti-friction type bearings on the vertical shaft are of ample size and weight to sustain the vertical thrust of the pump impeller. A gear-type lube oil pump is built into the unit.

The right angle stage features spiral bevel gears, while reduction is achieved through precision helical gears.

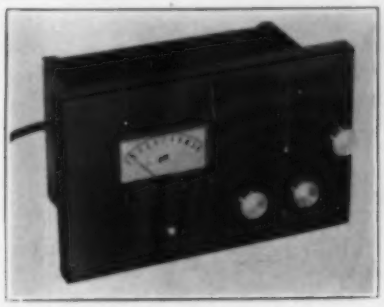
Salt Water Current Meter

109

W. & L. E. Gurley, Troy, N. Y., has developed a salt water model of the Gurley Current Meter.

The new salt water model incorporates a commutator which indicates each tenth revolution of the bucket wheel. A commutator for indicating single revolutions can also be supplied. The commutator box is positively sealed, excluding salt water, a conductor of electricity, from the contact chamber—thus preventing the meter being rendered inoperative by short circuits across the contact points.

The meters are available in a variety of outfits—for use by overhead-cable suspension, wading-rod suspension, and exploration or survey parties. Gurley also makes the Pygmy for shallow streams, flumes and canals.



pH Meter Features Quick Servicing, Versatility

110

Beckman Instruments, Inc., South Pasadena, Calif., has announced a compact, panel-mounted automatic pH meter, that can be serviced in minutes by personnel right on the job.

It represents the first industrial pH meter to accommodate virtually any combination of recorder and meter ranges. Its circuit allows the recorder pH scale to be shifted up or down, expanded or compressed. The entire pH range or as few as 3 pH units can be recorded full-scale on the recorder chart.

Circuits of the new meter are designed in three "plug-in" units, which can be instantly replaced by spares without disturbing panel connections. This feature insures uninterrupted control of pH in industrial processes without the need for trained repair specialists.

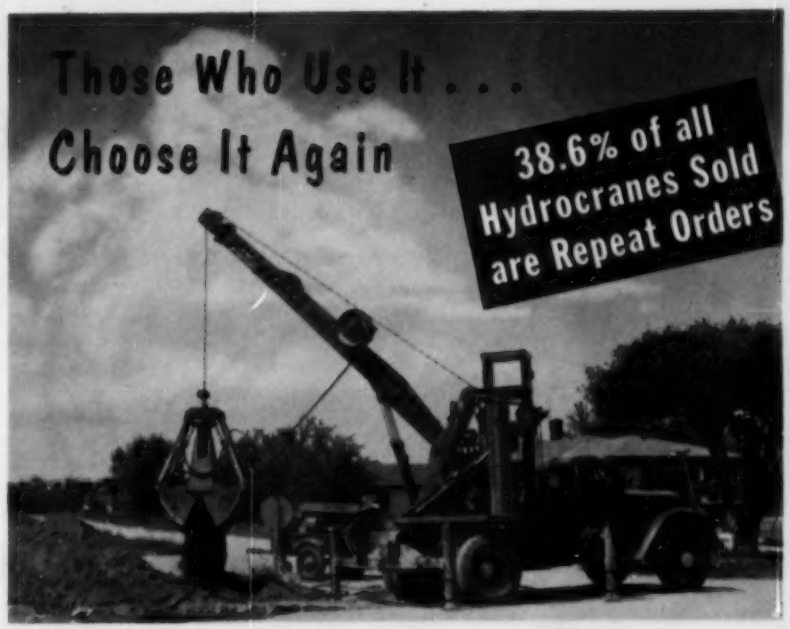
The circuit units are mounted on the inside of the meter door, with the housing itself permanently installed on a rack or panel. The door can be lifted entirely off its hinges, enabling complete dissassembly of the instrument in less than 10 minutes with just a screwdriver.

Hydraulic Digging Wheel Control On Trenchliner

111

The Parsons Company, Newton, Iowa, has announced that hydraulic control of the digging wheel is an important feature of the new 150 wheel-type Trenchliner.

Digging wheel travels up and down a vertical mast. Hydraulic ram raises and lowers the wheel, holds close grade tolerance at any depth. Mast is also power controlled. A separate hydraulic ram tilts the mast to carry weight of the wheel forward on the machine for proper balance when traveling, loading or unloading on trucks or trailers. The Model 150 is equipped with a range of 30 digging feeds, and three speeds on the heavy-duty digging wheel up to 11.25 r.p.m.



Yes, 38.6 percent of all Hydrocranes sold are additional machines bought by satisfied users. In fact, many owners are now fleet operators — buying a 3rd, 4th, 5th and even a 6th Hydrocrane! Here's real proof that this all-hydraulic truck crane produces big, gives owners an extra profit pay-off.

Only Hydrocrane gives you all these:

- **"Reach-ability" with hydraulically telescoping boom.**
- **Maneuverability with extremely short tail swing, lower overall height.**
- **Stability with four hydraulically controlled outriggers.**
- **Mobility with speeds up to 50 mph.**
- **"Control-ability" with full hydraulic, finger tip control.**
- **Convertibility — quickly changed to dragshovel front end right in the field.**

Plus these additional features:

- **Self-power — Hydrocrane has its own independent power unit. (optional)**
- **Remote control — start it, drive it, turn it, stop it right from the crane cab. (optional)**
- **Selector unit — foot control channels *extra* hydraulic fluid to line hoist bank — gives you 50% faster line speed. (optional)**
- **Increased line speeds — even without selector valve unit, all line speeds are now 10% faster.**
- **New pressure relief valve — provides even better control of hydraulic pressure.**
- **Increased crane rating — maximum capacity now 4-ton with two-part hoist.**
- **Wrist-action dipper for Hydrohoe — provides variable digging angles . . . delivers extra digging power.**

49H54

BUCYRUS ERIE HYDROCRANE

Arrange a demonstration now!

BUCYRUS-ERIE COMPANY South Milwaukee, Wisconsin

W & SW

Men in the News

Mueller Promotes Baker

Mueller Co., Decatur, Illinois, has announced the promotion of E. George Baker to the position of Assistant Sales Manager of the Company Los Angeles Plant.

Mr. Baker's new position puts him in charge of all sales personnel of the Los Angeles Plant. He assumed his new duties in December, 1954.

Armco Opens Jefferson City Plant

Armco Drainage & Metal Products, Inc., Middletown, Ohio, has announced the opening of the new Jefferson City, Missouri, plant.

The new plant will fabricate metal drainage pipe, eliptically-shaped pipe arch for use where headroom is low, and special fittings to adapt the pipe and pipe arch to a wide variety of drainage conditions.

The products of the Jefferson City plant will be especially adapted to road construction and municipal sewer installations. In addition, the plant will maintain stocks of other Armco Drainage products. Armco foundation piling, Hel-Cor pipe, MULTI-PLATE, Liner Plate, Flex Beam highway guardrail, and sheeting will be kept on hand for the convenience of Missouri contractors.

f-l-e-x-i-b-l-e pipe cleaning company

9324 So. Norwalk Blvd., Los Nietos, California • P.O. Box 167 • OXford 5-5713

P. O. Box 191, South Houston, Texas

Take one minute to read the A-B-C's of Water main Cleaning!

How old are the water mains in your city's system? When did you last check on pipe condition...on system pressure? If you are considering raising volume and pressure with bigger pumps, or replacing clogged mains, see Flexible first for these basic ways to save dollars by cleaning those clogged mains and restoring them to top efficiency.

✓ A - More Pressure for better service throughout the system ...for improved fire fighting needs and lower under-writers insurance rates -- all without disturbing the lines themselves. That's the Flexible way!

✓ B - Increased Capacity to handle population growth without making unnecessary investments in pumps or larger diameter lines. That's the Flexible way!

✓ C - Lower Cost with experienced crews and specialized equipment that can restore pipe to a guaranteed 90% of new pipe efficiency. That's the Flexible way!

Send -- today -- for our Job Cost Estimate form. We'll be glad to provide our estimate for your particular job, and without cost or obligation.

Flexible has specialized equipment and crews for sterilizing water mains — Write for full details!

Tennessee Corp. Announces Promotions

Tennessee Corporation, Atlanta, Georgia, has announced that Mr. E. H. Shelton, formerly Sales Manager of the Atlanta sales office, has been appointed to the newly created position of General Sales Manager with offices in New York.

L. S. Kaniecki was promoted to Manager, Chemical Sales, and H. G. Cunningham Assistant Manager, Chemical Sales, with offices in Atlanta. R. W. Alexander was appointed Assistant General Manager of the Company's Lockland, Ohio.

Rhodia Appoints Nichols To Head Alamask Division

Rhodia, Inc., New York, N. Y., has announced the appointment of H. C. Nichols as head of the Engineering Service Section of the Industrial Reodorants (Alamask) Division.

The creation of the Engineering Service Section follows the announcement by Rhodia of the commercial availability of three new, industrial reodorants for odor abatement in sewage systems, dumps, lagoons and settling ponds.

A graduate of University of Michigan in 1932, Mr. Nichols started his career with Swift & Co., as super-

visor in charge of glycerine refining. From 1943 until 1947 he was with American Cyanamid Company in charge of pharmaceuticals, and in charge of the air pollution abatement program.

In 1948 Mr. Nichols joined Merck & Co., as associate in charge of the group engineering division responsible for industrial waste treatment and air pollution abatement engineering design for all Merck plants. For the past year he has been with the Engineering Corp. of America, consultant in engineering design for industrial waste treatment and odor abatement for the chemical process and petroleum industries.

American Well Works Appoints Representative

Water & Sewage Equipment Company, 711 West Lake Street, Minneapolis 8, Minn., has been appointed as sales representative for the states of Minnesota, North Dakota and South Dakota by the American Well Works, Aurora, Illinois.

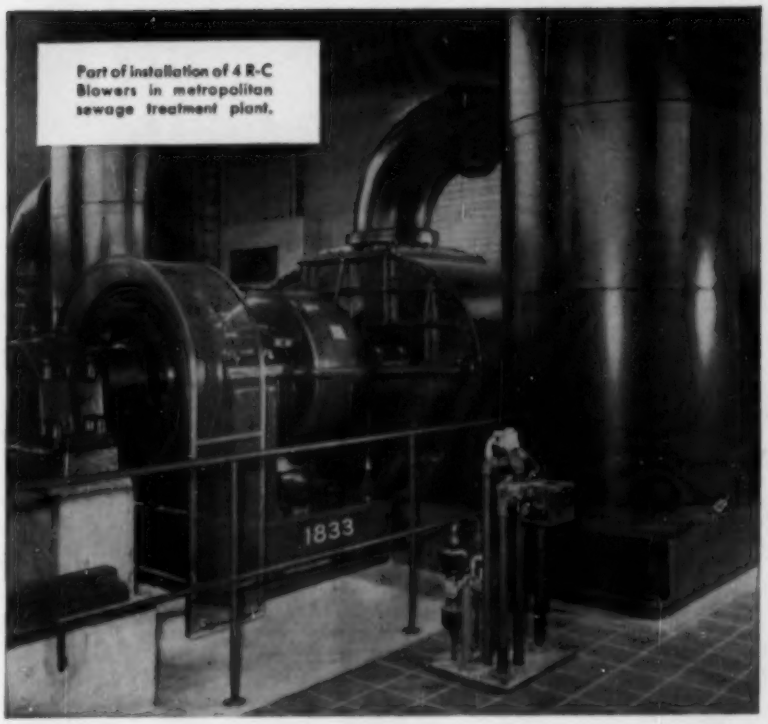
Operation of this firm of sales representatives is under the personal direction of Mr. J. W. Dousette, General Manager. Mr. Dousette is well known in the sewage, industrial waste and water treatment fields through his many years of association with the Iowa Valve Company and his activity as General Sales Manager of Iowa Valve Division of the Clow Company.

Rockwell Reorganizes Midwest Sales Set-Up

Rockwell Manufacturing Company's Meter and Valve Division, Pittsburgh, Pa., has announced the reorganization of its entire Midwestern sales set-up to provide for increased service to customers throughout that section, according to L. A. Dixon, Jr., vice-president.

As a first step, Mr. Dixon said, Carl K. Madison, Midwestern regional manager, has been promoted to vice-president in charge of new product sales for the entire division, and the Midwestern sales region has been divided into two new regions—a Southwestern and a smaller Midwestern region.

Roy R. Bush, Tulsa, Okla., district manager, has been named Midwestern regional manager with headquarters at Tulsa; and W. R. McLaughlin, manager of the Dallas office, becomes Southwestern regional manager with headquarters at Dallas.



Part of installation of 4 R-C Blowers in metropolitan sewage treatment plant.

No failures in volume or pressure with R-C Rotary Blowers

CHECK THE "BIG 4" ESSENTIALS

1. Accurate volume at required pressure
2. High efficiency—low operating cost
3. Low maintenance cost —low down time
4. Freedom from oil or oil vapor contamination

Check your present blowers and if they don't measure up, it may be an economy to replace them with modern R-C equipment.

In any capacity, from 5 cfm to 50,000 cfm, R-C Rotary Positive Blowers faithfully and accurately deliver their rated volumes and pressures. That's one most important reason for their wide use in sewage treatment plants where positive control of these two basic characteristics is essential.

But there are other reasons, too, for the selection of R-C Blowers wherever air must be moved for industrial processing. Check the accompanying list of "BIG 4" essentials and you'll see why sturdy R-C Rotary Positive Blowers have long been "standard" with thousands of purchasers for widely varying applications.

If you have a job of moving air or gas, call the R-C engineer. With Rotary Positives, Centrifugals and the new Spiraxials, he can give you unbiased counsel and suggestions. Or, write us about your needs, and we'll send informative bulletins on equipment for new installations or replacements.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
155 Mount Ave. • Connersville, Indiana

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W&SW

New Literature

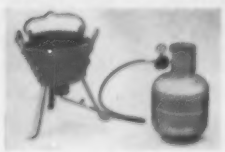
Continuous Gravimetric Proportioning Systems

112

Proportioneers, Inc., Division of B-I-F Industries, Inc., Providence, R. I., has reprinted an article on **"Continuous Gravimetric Proportioning Systems"** in the form of an applications bulletin. Written by R. P. Lowe, President of Proportioneers, Inc., this bulletin contains photographs, diagrams, flowgrams, and chapters on: Considerations; Which System to Use; Loss-In-Weight Proportioning Systems; Proportioning of TEL and gasoline; Proportioning Multiple Liquids; Pulp-Sheet Feeding in Alpha-Cellulose Manufacture; Belt-Type Gravimetric Feeders; Compounding of Fertilizer Mixtures; Belt Feeders with Pneumatic Load Cells; and Electronic Load Cells.

Pipe Line Equipment
WATER • GAS • SEWER

Bottled Gas Lead Melting Furnace



Calking Tool Outfit

For water mains up to 12". Strong leather bag. Keeps the right tool for every job within easy reach.

Portable Lead Melting Furnace

A handy outfit for quick action, equipped with gasoline burner.

Asbestos Joint Runners

Best quality asbestos rope, brass caps attached to each end. Equipped with clamps.

Test Plugs for Bell or Spigot End Cast Iron Pipe.

Pipe Cutter

Inexpensive way of cutting pipe. Every wheel in contact with the pipe is a cutting disc, so cutter need be moved only a short distance to cut entirely around the pipe.

M-D Cut-In Connections for Sewers

A light cast iron fitting with bell end for connecting house service with main sewer pipe without necessity for placing a Y-branch or T-branch in the sewer line.

Tapax

The original manhole cushion. Takes the bang out of manhole covers.

Leak Detector

A truly fine instrument designed to solve even the most difficult leak detecting problem.

On this page are shown only a few of the hundreds of items to be found in the POLLARD Catalog. Write for a copy of Catalog No. 25G.

M-Scope Pipe Finder

It's easy to locate a buried pipe line with this handy pipe finder.

JOSEPH G. POLLARD CO., INC.

Western Office
1064 Peoples Gas Bldg.
Chicago, Ill.

MAIN OFFICE AND FACTORY
New Hyde Park, N. Y.

Southern Office
333 Chandler Bldg.
Atlanta, Ga.

Backflow and Back-Siphonage Preventer

113

Hersey Manufacturing Company, South Boston, Mass., has just published a 4-page folder on their **Backflow and Back-Siphonage Preventer.**

The folder contains a complete description of the unit and lists its advantages. A cut-away photograph with keyed text explains the operation of the preventer. A dimension line drawing and tables are also included.

The back page contains a series of six charts showing the loss of pressure curves for the unit from the 2 inch size through the 10 inch size.

Automatic Sewage Wet Well Pump Control

114

Builders-Providence, Inc., Division of B-I-F Industries, Inc., Providence, R. I., has announced the issuance of an application bulletin that describes the operation of a simple, non-clogging, pneumatically-operated **Wet Well Pump Control Package.** This bulletin, with a clear, easy-to-read Flowgram, tells how this dependable, low-cost package starts, stops and controls the speed of wet well pumps while increasing station operational efficiency and substantially decreasing maintenance.

Plumbing Chemicals

115

The Hercules Chemical Company, New York, N. Y., has announced the publication of a new 4 page descriptive catalog for industrial, institutional, farm and home reference incorporating its entire line of **Plumbing Chemicals** sold through authorized wholesalers.

The new catalog includes drain pipe cleaners, cesspool and septic tank cleaner, boiler compounds, root destroyer, a new prepared solder and flux, cutting oils and pipe joint compounds. In all, the catalog covers 24 of Hercules' most popular plumbing chemicals.

Water in Process Use

116

Hall Laboratories, Inc., Pittsburgh, Pa., has just released a 6-page folder entitled **"Water in Process Use"** that discusses the value of a broad approach to industrial water problems through an overall survey of process water.

The folder gives examples of how a process water survey to find out how water is being used—or wasted—in a plant can have some or all of the following benefits: conservation of critical materials, reduction of water use, and savings in waste-water treatment.

Special knowledge and experience applied to one water problem will often lead to "fringe benefits," unplanned for, but nonetheless welcome, are discussed.

Recording Controlling, And Telemetering Bulletin

117

The Bristol Company, Waterbury, Conn., has just issued a new general bulletin listing and illustrating their complete line of **Recording Automatic Controlling, and Telemetering Instruments.**

The bulletin features the new line of Metagraphic Pneumatic Transmission instruments, which divide the functions of measuring, recording, and controlling into three separate instruments to achieve maximum flexibility in application. The Metagraphic receivers also have the feature of quick interchangeability of recorders and indicators. The changeover is accomplished without loss of signal pressure or control.

In addition to the Metagraphic line, the bulletin illustrates and describes briefly the full line of recorders and controllers for temperature, flow, liquid level, mechanical motion, running time, count, and operation, and speed.

Turbine Pumps

118

The A. O. Smith Corporation, Pacific Coast Works, Los Angeles, Calif., has just issued an 8-page bulletin entitled **"Turbine Pumps for Industry."**

The bulletin describes and illustrates the latest models of vertical turbine pumps being manufactured at the Pacific Coast plant. These pumps are part of the new line being developed by the Hydraulic Products group of the Corporation.

Included in the bulletin are characteristic curves and detailed descriptions of the principal components. Drawings of typical applications are also shown.

BIG valve...little space

The disc in this 84-in. low pressure Butterfly Valve must withstand 138,000 lbs. of force when closed against a 25 P.S.I. line pressure . . . yet the face to face dimension is only 18 in. and the entire valve weighs just 12,000 lbs. Even under this severe loading Pratt design keeps the bearing pressure well below 2500 P.S.I.

Pratt Rubber Seat Butterfly Valves are manufactured in sizes from 10 in. to 168 in. in diameter, in pressure ratings up to 125 P.S.I. Their low initial cost, easy installation and proven low maintenance make them the logical solution to valving problems, both for new projects and as replacements.

The Henry Pratt Company originated and has been making this type of valve for over 28 years. Our background represents the greatest cumulative experience in the industry. It is the reason why Pratt Valves are so convenient to install, easy to operate and give long years of trouble-free service. **For full details write for Bulletin 1-C.**

HENRY PRATT

Send for informative booklet "Understanding Butterfly Valves."

RUBBER SEAT Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

14 YEARS LATER

8 Climax Engines installed in 1940 in the Rock Island, Illinois, Sewage Treatment Plant are "all in excellent shape today," reports Mr. Armin J. Grossell, Supt. of Public Service.

2 Engines, rated 75 HP at 720 RPM respectively driving sewage pumps have a total of 12½ years operation between them.

1 Engine, direct connected to a 720 RPM generator has run over 75,000 hours.

5 Engines, rated 125 HP at 1200, connected to storm sewer pumps, operate only during emergencies. One of the 5 has logged 24,000 hours.

A careful maintenance program has contributed to the fine engine performance. Such performance is to be expected when you specify Climax.

Plant designed by and built under supervision of Consoer, Townsend and Associates.

climax

FOR COMPLETE INFORMATION, WRITE TO . . .

ENGINE AND PUMP MFG. CO.

208 So. La Salle St.

CHICAGO 4, ILLINOIS

Factory–Clinton, Ia. *District Office*–Dallas, Tex.

GATE OPERATORS — PORTABLE — FOR STANDS & UNDERGROUND GATES—MOTOR TRUCK MOUNTED

PAYNE DEAN & CO.

CLINTON, CONN.

Instrumentation Catalog

119

Fischer & Porter Company, Hatboro, Pa., has available a new 12-page **General Catalog** with illustrations, descriptions, and basic specifications of the company's complete line of process instruments.

The listing of instruments for measuring and controlling process variables includes: variable-area and variable-head flow waters; pressure instruments; temperature instruments; liquid level instruments; density and specific gravity measuring instruments; viscosity and consistency instruments; electric, pneumatic, and electronic transmitting, recording and controlling instruments with alarms and integrators; and air-operated control valves in various models and construction materials.

The catalog also lists Fischer & Porter's complete industrial package that includes centralized control panels, both standard and graphic; data reduction and automation systems; chlorination equipment for industrial, municipal, and swimming water and waste treatment, and chlorine evaporators; and industrial glass products for laboratories and manufacturing plants.

Proportioning Pump

120

Hills-McCanna Co., Chicago, Illinois, has announced the release of a six-page bulletin describing the **"Hills-McCannameter"**—a new type of proportioning pump with no packing, unique high speed valves and pulse free flow.

The new bulletin, printed in color, tells what the "Hills-McCannameter" is; why it was designed; what it will do and how it works.

Special Lay-Out Paper For Planning Water And Sewage Systems

121

Automatic Control Company, St. Paul, Minn., has recently created **Special Field Sketch Pads** to aid field engineer in laying out and planning water and sewage systems.

A number of special symbols were also designed by the company and are printed on the sheets to help the industry standardize on simple pictorial representations of water treatment and sewage processing elements that must constantly be illustrated.

These field sketch pads, printed on light-weight stock in orange ink, are available to engineers, consultants and others in the water, sewage and process industries.

Pressure Filters

122

The Permutit Co., New York, N. Y., has available a comprehensive and well documented bulletin describing their line of **Pressure Filters** and accessories.

According to the bulletin, these filters are now being used to remove suspended solids such as dirt, turbidity, iron, oil and color. Specifications, operating characteristics, outline dimensions and typical installation photographs have been included in this revised edition.

Rawhide Packing

123

Mabbs Hydraulic Packing Co., Chicago, Illinois, has available an information sheet on **Mabbs Rawhide Packing** for sludge, sewage, and waterworks pumps.

According to the information sheet, the rawhide packing prevents scoring of shafts, saves shutdowns, saves replacements, and saves power. A list of advantages, specifications and statements from current users of the packing are also included in the information sheet.

Submersible Pumps

124

Pleuger Submersibles Engineering and Manufacturing Co., Lancaster, Pa., has just released a 24-page catalog describing the complete line of **Pleuger Submersible Pumps.**

Sub-divided into five sections, the catalog provides general information about the company, technical information to aid in selecting the right pump for a specific job, pump types, electrical data and prices.

The catalog also describes in detail the unique feature of the Pleuger pump which is the only submersible equipped with a water-filled and water-lubricated motor which requires no seal or stuffing box.

WANTED

"Sanitary Engineer to direct comprehensive sanitation program. Salary $5460-$6360. Cattaraugus County Health Department, Olean, New York."

WANTED:
Position as Water Works Superintendent in the New England area. Age 33, married, B. S. degree, 8 years experience in operation. Presently employed design capacity. Desire change. Write Box 1124, WATER & SEWAGE WORKS, 185 North Wabash Ave., Chicago 1, Illinois.

1. Large illustration shows Singl-use Fiberform ready to be filled.
2. Filling plate and collar simplify pouring concrete into form.
3. Completed meter box barrel.
4. Meter box with cover in place.

FOR ECONOMICAL SETTINGS

Make Your Own

CONCRETE METER BOX BARRELS *with*

FORD

Singl-use Fiberforms

Water utilities that find vitrified or concrete tile expensive or difficult to obtain, may now make their own barrels for outside meter settings with Ford Singl-use Fiberforms which are inexpensive and easy to use. Forms made for 15", 18" and 20" ID barrels and in lengths of 15", 18" and 24". Use two for deep settings. Send for full information.

FOR BETTER WATER SERVICES **FORD**

THE FORD METER BOX COMPANY, INC. Wabash, Indiana

HYDRO-TITE

DEPENDABLE JOINTING COMPOUND

Seals Bell and Spigot Water Mains

Economical—Effective

Over 35 Years Of Dependable Performance

HYDRAULIC DEVELOPMENT CORP.

MAIN SALES OFFICE 50 CHURCH ST., N. Y. C.

General offices and works W. Medford Sta., Boston, Mass.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

CEMENT GUN COMPANY SOLVES
TWO RESERVOIR PROBLEMS WITH "GUNITE"

Photo at left shows crumbling condition of an 80' circular brick reservoir in a western Pennsylvania town. It was one of two such reservoirs owned by the municipality, the other being 50' in diameter. Both leaked badly and were too small to provide desired storage. Photo at right shows how the Cement Gun Company crew solved both problems by coating sides with "GUNITE" and extending the walls 6' in height with pre-stressed "GUNITE." Leakage, of course, was eliminated and the capacity of both reservoirs was increased more than 50%. This is just one of many examples of how the Cement Gun Company has been able to rebuild and reconstruct water storage structures to better-than-new condition and, at the same time, provide needed additional capacity.

For illustrations of other "GUNITE" jobs, ask on your letterhead for free copy of Bulletin C 3000 today.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES – ALLENTOWN, PA., U. S. A.

MANUFACTURERS OF THE "CEMENT GUN"

IT PAYS TO *Specify*
LEOPOLD
Glazed Tile
FILTER BOTTOMS

Here's why—

Permanent • No corrosion or tuberculation • Equal distribution • Low loss of head • Requires only small sized gravel • No metal in contact with water!

Write today for details

F. B. Leopold Co., Inc.
2413 W. Carson Street
Pittsburgh 4, Pa.

ROTO-TROL

RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION
HEALY-RUFF COMPANY
703 HAMPDEN AVE., ST. PAUL 4, MINN.

Engine-Generator Sets

125

Le Roi Division of Westinghouse Air Brake Co., Milwaukee, Wis., has just published an 8-page bulletin describing **Le Roi Engine-Generator** sets in seven engine models from 60 to 675 hp. with generators capable of producing from 50 to 350 KW.

The "Custom Built" features highlighted in the literature include alternate fuel systems which permit the use of natural gas, LPG, gasoline and gas-gasoline or sludge gas fuels; a choice of radiator, heat exchanger or city water cooling systems; electric; automatic or engine starting; mechanical, full hydraulic or semi-hydraulic governors; and oil pressure and water temperature safety switches. Installation drawings show basic dimensions for all models.

Electric Motor Catalog

126

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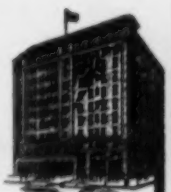

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Water Works Plant (Completed in 1953)

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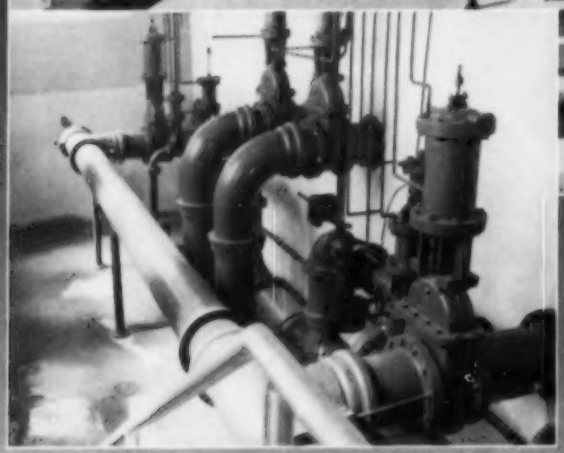
The 1.0 M.G.D. Thomson Water Works Plant showing flocculation and sedimentation basins in foreground. Filters have Wheeler Bottoms by Builders-Providence.



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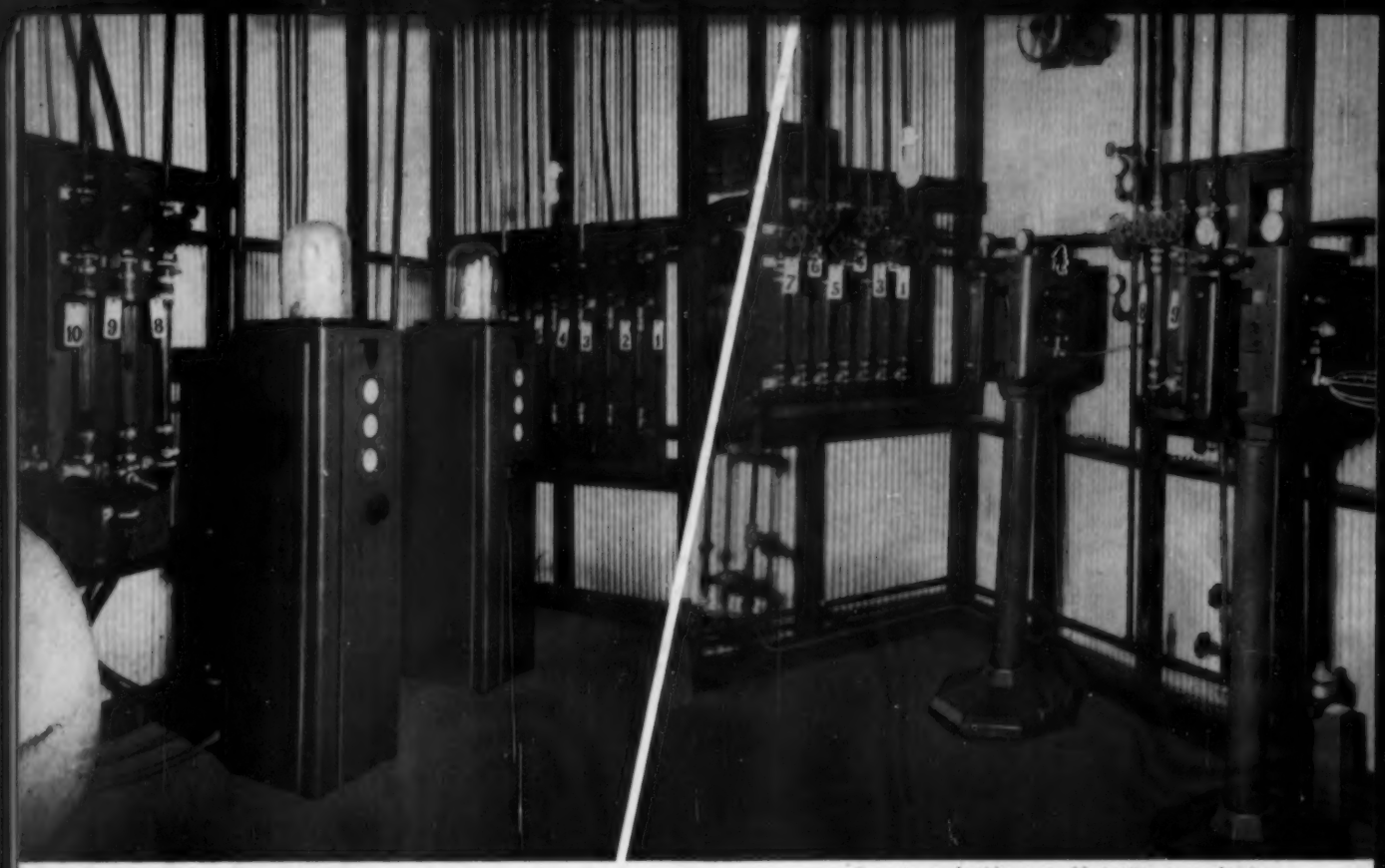

Two views of midwestern chlorinating room showing typical use of W&T equipment to suit a specific need.

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